ARMY
13.2 Small Business Innovation Research (SBIR)
Proposal Submission Instructions

INTRODUCTION

The US Army Research, Development, and Engineering Command (RDECOM) is responsible for execution of the Army SBIR Program. Information on the Army SBIR Program can be found at the following Web site: https://www.armysbir.army.mil.

Solicitation, topic, and general questions regarding the SBIR Program should be addressed according to the DoD Program Solicitation. For technical questions about the topic during the pre-release period, contact the Topic Authors listed for each topic in the Solicitation. To obtain answers to technical questions during the formal Solicitation period, visit http://www.dodsbir.net/sitis. Specific questions pertaining to the Army SBIR Program should be submitted to:

John Smith
Program Manager, Army SBIR
army.sbir@us.army.mil
US Army Research, Development and Engineering Command (RDECOM)

ATTN: AMSRD-PEB
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The Army participates in three DoD SBIR Solicitations each year. Proposals not conforming to the terms of this Solicitation will not be considered. Only Government personnel will evaluate proposals with the exception of technical personnel from The Geneva Foundation who will provide Advisory and Assistance Services to the Army, providing technical analysis in the evaluation of proposals submitted against Army topic numbers: A13-090.

Individuals from The Geneva Foundation will be authorized access to only those portions of the proposal data and discussions that are necessary to enable them to perform their respective duties. This firm is expressly prohibited from competing for SBIR awards and from scoring or ranking of proposals or recommending the selection of a source. In accomplishing its duties related to the source selection process, the aforementioned firm may require access to proprietary information contained in the offerors' proposals. Therefore, pursuant to FAR 9.505-4, these firms must execute an agreement that states that they will (1) protect the offerors' information from unauthorized use or disclosure for as long as it remains proprietary and (2) refrain from using the information for any purpose other than that for which it was furnished. These agreements will remain on file with the Army SBIR program management office at the address above.

PHASE I PROPOSAL SUBMISSION

SBIR Phase I proposals have four Volumes: Proposal Cover Sheets, Technical Volume, Cost Volume and Company Commercialization Report. The Technical Volume has a 20-page limit including: table of contents, pages intentionally left blank, references, letters of support, appendices, technical portions of subcontract documents (e.g., statements of work and resumes) and any other attachments. Do not include blank pages, duplicate the electronically generated cover pages or put information normally associated with the Technical Volume in other sections of the proposal as these will count toward the 20 page limit.

Only the electronically generated Cover Sheets, Cost Volume and Company Commercialization Report (CCR) are excluded from the 20-page limit. The CCR is generated by the proposal submission website, based on information provided by you through the Company Commercialization Report tool.

Army Phase I proposals submitted containing a Technical Volume over 20 pages will be deemed NON-COMPLIANT and will not be evaluated.

Phase I proposals must describe the "vision" or "end-state" of the research and the most likely strategy or path for transition of the SBIR project from research to an operational capability that satisfies one or more Army operational or technical requirements in a new or existing system, larger research program, or as a stand-alone product or service.

Phase I proposals will be reviewed for overall merit based upon the criteria in Section 6.0 of the DoD Program Solicitation.

13.2 Phase I Key Dates

Solicitation closes, proposals due	26 June 2013
Phase I Evaluations	June – August 2013
Phase I Selections	August 2013
Phase I Award Goal	October 2013*

**Subject to the Congressional Budget process*

PHASE I OPTION MUST BE INCLUDED AS PART OF PHASE I PROPOSAL

The Army implements the use of a Phase I Option that may be exercised to fund interim Phase I activities while a Phase II contract is being negotiated. Only Phase I efforts selected for Phase II awards through the Army's competitive process will be eligible to have the Phase I Option exercised. The Phase I Option, which **must** be included as part of the Phase I proposal, should cover activities over a period of up to four months and describe appropriate initial Phase II activities that may lead to the successful demonstration of a product or technology. The Phase I Option must be included within the 20-page limit for the Phase I proposal.

PHASE I COST VOLUME

A firm fixed price or cost plus fixed fee Phase I Cost Volume ($150,000 maximum) must be submitted in detail online. Proposers that participate in this solicitation must complete Phase I Cost Volume not to exceed a maximum dollar amount of $100,000 and six months and a Phase I Option Cost Volume not to exceed a maximum dollar amount of $50,000 and four months. The Phase I and Phase I Option costs must be shown separately but may be presented side-by-side in a single Cost Volume. The Cost Volume DOES NOT count toward the 20-page Phase I proposal limitation. When submitting the Cost Volume, complete the Cost Volume form on the DoD Submission site, versus submitting within the body of the uploaded proposal.

PHASE II PROPOSAL SUBMISSION

Commencing with Phase II's resulting from a 13.1 Phase I, invitations are no longer required. Small businesses submitting a Phase II Proposal must use the DoD SBIR electronic proposal submission system (http://www.dodsbir.net/submission/). This site contains step-by-step instructions for the preparation and submission of the Proposal Cover Sheets, the Company Commercialization Report, the Cost Volume, and how to upload the Technical Volume. For general inquiries or problems with proposal electronic submission, contact the DoD Help Desk at 1-866-724-7457 (8:00 am to 5:00 pm EST).

Phase II proposals can be submitted by Phase I awardees only within one of four submission cycles shown below and must be submitted between 5 to 17 months after the Phase I contract award date. Any proposals that are not submitted within these four submission cycles and before 5 months or after 17 months from the contract award will not be evaluated.

SUBMISSION CYCLES	TIMEFRAME
Cycle One	30 calendar days starting on or about 15 October*
Cycle Two	30 calendar days starting on or about 1 March*
Cycle Three	30 calendar days starting on or about 15 June*
Cycle Four	30 calendar days starting on or about 1 August*

*Submission cycles will open on the date listed unless it falls on a weekend or a Federal Holiday. In those cases, it will open on the next available business day.

Army SBIR Phase II Proposals have four Volumes: Proposal Cover Sheets, Technical Volume, Cost Volume and Company Commercialization Report. The Technical Volume has a 38-page limit including: table of contents, pages intentionally left blank, references, letters of support, appendices, technical portions of subcontract documents (e.g., statements of work and resumes) and any attachments. Do not include blank pages, duplicate the electronically generated cover pages or put information normally associated with the Technical Volume in other sections of the proposal as these will count toward the 38 page limit.

Only the electronically generated Cover Sheets, Cost Volume and Company Commercialization Report (CCR) are excluded from the 38-page limit. The CCR is generated by the proposal submission website, based on information provided by you through the Company Commercialization Report tool.

Army Phase II Proposals submitted containing a Technical Volume over 38 pages will be deemed NON-COMPLIANT and will not be evaluated.

Army Phase II Cost Volumes must contain a budget for the entire 24 month Phase II period not to exceed the maximum dollar amount of $1,000,000. During contract negotiation, the contracting officer may require a Cost Volume for a base year and an option year. These costs must be submitted using the Cost Volume format (accessible electronically on the DoD submission site), and may be presented side-by-side on a single Cost Volume Sheet. The total proposed amount should be indicated on the Proposal Cover Sheet as the Proposed Cost. Phase II projects will be evaluated after the base year prior to extending funding for the option year.

Small businesses submitting a proposal are required to develop and submit a technology transition and commercialization plan describing feasible approaches for transitioning and/or commercializing the developed technology in their Phase II proposal.

DoD is not obligated to make any awards under Phase I, II, or III. For specifics regarding the evaluation and award of Phase I or II contracts, please read the DoD Program Solicitation very carefully. Phase II proposals will be reviewed for overall merit based upon the criteria in Section 8.0 of the solicitation.

BIO HAZARD MATERIAL AND RESEARCH INVOLVING ANIMAL OR HUMAN SUBJECTS

Any proposal involving the use of Bio Hazard Materials must identify in the Technical Volume whether the contractor has been certified by the Government to perform Bio Level - I, II or III work.

Companies should plan carefully for research involving animal or human subjects, or requiring access to government resources of any kind. Animal or human research must be based on formal protocols that are reviewed and approved both locally and through the Army's committee process. Resources such as equipment, reagents, samples, data, facilities, troops or recruits, and so forth, must all be arranged carefully. The few months available for a Phase I effort may preclude plans including these elements, unless coordinated before a contract is awarded.

FOREIGN NATIONALS

If the offeror proposes to use a foreign national(s) [any person who is NOT a citizen or national of the United States, a lawful permanent resident, or a protected individual as defined by 8 U.S.C. 1324b (a) (3) – refer to Section 3.4 of this solicitation for definitions of "lawful permanent resident" and "protected individual"] as key personnel, they must be clearly identified. **For foreign nationals, you must provide country of origin, the type of visa or work permit under which they are performing and an explanation of their anticipated level of involvement on this project. Please ensure no Privacy Act information is included in this submittal.**

OZONE CHEMICALS

Class 1 Ozone Depleting Chemicals/Ozone Depleting Substances are prohibited and will not be allowed for use in this procurement without prior Government approval.

CONTRACTOR MANPOWER REPORTING APPLICATION (CMRA)

The Contractor Manpower Reporting Application (CMRA) is a Department of Defense Business Initiative Council (BIC) sponsored program to obtain better visibility of the contractor service workforce. This reporting requirement applies to all Army SBIR contracts.

Offerors are instructed to include an estimate for the cost of complying with CMRA as part of the Cost Volume for Phase I ($100,000 maximum), Phase I Option ($50,000 maximum), and Phase II ($1,000,000 maximum), under "CMRA Compliance" in Other Direct Costs. This is an estimated total cost (if any) that would be incurred to comply with the CMRA requirement. Only proposals that receive an award will be required to deliver CMRA reporting, i.e. if the proposal is selected and an award is made, the contract will include a deliverable for CMRA.

To date, there has been a wide range of estimated costs for CMRA. While most final negotiated costs have been minimal, there appears to be some higher cost estimates that can often be attributed to misunderstanding the requirement. The SBIR Program desires for the Government to pay a fair and reasonable price. This technical analysis is intended to help determine this fair and reasonable price for CMRA as it applies to SBIR contracts.

- The Office of the Assistant Secretary of the Army (Manpower & Reserve Affairs) operates and maintains the secure CMRA System. The CMRA Web site is located here: https://cmra.army.mil/.

- The CMRA requirement consists of the following items, which are located within the contract document, the contractor's existing cost accounting system (i.e. estimated direct labor hours, estimated direct labor dollars), or obtained from the contracting officer representative:

  (1) Contract number, including task and delivery order number;
  (2) Contractor name, address, phone number, e-mail address, identity of contractor employee entering data;
  (3) Estimated direct labor hours (including sub-contractors);
  (4) Estimated direct labor dollars paid this reporting period (including sub-contractors);

(5) Predominant Federal Service Code (FSC) reflecting services provided by contractor (and separate predominant FSC for each sub-contractor if different);
(6) Organizational title associated with the Unit Identification Code (UIC) for the Army Requiring Activity (The Army Requiring Activity is responsible for providing the contractor with its UIC for the purposes of reporting this information);
(7) Locations where contractor and sub-contractors perform the work (specified by zip code in the United States and nearest city, country, when in an overseas location, using standardized nomenclature provided on Web site);

- The reporting period will be the period of performance not to exceed 12 months ending September 30 of each government fiscal year and must be reported by 31 October of each calendar year.

- According to the required CMRA contract language, the contractor may use a direct XML data transfer to the Contractor Manpower Reporting System database server or fill in the fields on the Government Web site. The CMRA Web site also has a no-cost CMRA XML Converter Tool.

Given the small size of our SBIR contracts and companies, it is our opinion that the modification of contractor payroll systems for automatic XML data transfer is not in the best interest of the Government. CMRA is an annual reporting requirement that can be achieved through multiple means to include manual entry, MS Excel spreadsheet development, or use of the free Government XML converter tool. The annual reporting should take less than a few hours annually by an administrative level employee.

Depending on labor rates, we would expect the total annual cost for SBIR companies to not exceed $500.00 annually, or to be included in overhead rates.

DISCRETIONARY TECHNICAL ASSISTANCE

In accordance with section 9(q) of the Small Business Act (15 U.S.C. 638(q)), the Army will provide technical assistance services to small businesses engaged in SBIR projects through a network of scientists and engineers engaged in a wide range of technologies. The objective of this effort is to increase Army SBIR technology transition and commercialization success thereby accelerating the fielding of capabilities to Soldiers and to benefit the nation through stimulated technological innovation, improved manufacturing capability, and increased competition, productivity, and economic growth.

The Army has stationed six Technical Assistance Advocates (TAAs) across the Army to provide technical assistance to small businesses that have Phase I and Phase II projects with the participating organizations within their regions.

For more information go to: https://www.armysbir.army.mil/sbir/TechnicalAssistance.aspx.

COMMERCIALIZATION READINESS PROGRAM (CRP)

The objective of the CRP effort is to increase Army SBIR technology transition and commercialization success and accelerate the fielding of capabilities to Soldiers. The CRP: 1) assesses and identifies SBIR projects and companies with high transition potential that meet high priority requirements; 2) matches SBIR companies to customers and facilitates collaboration; 3) facilitates detailed technology transition plans and agreements; 4) makes recommendations for additional funding for select SBIR projects that meet the criteria identified above; and 5) tracks metrics and measures results for the SBIR projects within the CRP.

Based on its assessment of the SBIR project's potential for transition as described above, the Army utilizes a CRP investment fund of SBIR dollars targeted to enhance ongoing Phase II activities with expanded research, development, test and evaluation to accelerate transition and commercialization. The

CRP investment fund must be expended according to all applicable SBIR policy on existing Phase II contracts. The size and timing of these enhancements is dictated by the specific research requirements, availability of matching funds, proposed transition strategies, and individual contracting arrangements.

NON-PROPRIETARY SUMMARY REPORTS

All award winners must submit a non-proprietary summary report at the end of their Phase I project and any subsequent Phase II project. The summary report is unclassified, non-sensitive and non-proprietary and should include:

- A summation of Phase I results
- A description of the technology being developed
- The anticipated DoD and/or non-DoD customer
- The plan to transition the SBIR developed technology to the customer
- The anticipated applications/benefits for government and/or private sector use
- An image depicting the developed technology

The non-proprietary summary report should not exceed 700 words, and is intended for public viewing on the Army SBIR/STTR Small Business area. This summary report is in addition to the required final technical report and should require minimal work because most of this information is required in the final technical report. The summary report shall be submitted in accordance with the format and instructions posted within the Army SBIR Small Business Portal at https://portal.armysbir.army.mil/SmallBusinessPortal/Default.aspx and is due within 30 days of the contract end date.

ARMY SUBMISSION OF FINAL TECHNICAL REPORTS

A final technical report is required for each project. Per DFARS clause 252.235-7011 (http://www.acq.osd.mil/dpap/dars/dfars/html/current/252235.htm#252.235-7011), each contractor shall (a) submit two copies of the approved scientific or technical report delivered under the contract to the Defense Technical Information Center, Attn: DTIC-O, 8725 John J. Kingman Road, Fort Belvoir, VA 22060-6218; (b) Include a completed Standard Form 298, Report Documentation Page, with each copy of the report; and (c) For submission of reports in other than paper copy, contact the Defense Technical Information Center or follow the instructions at http://www.dtic.mil.

ARMY SBIR PROGRAM COORDINATORS (PC)

Participating Organizations	PC	Phone
Aviation Missile RD&E Center (AMRDEC M)	Otho Thomas	(256) 842-9227
	Dawn Gratz	(256) 842-8769
Engineer Research & Development Center	Theresa Salls	(603) 646-4591
Medical Research & Materiel Command	JR Myers	(301) 619-7377
PEO Combat Support & Combat Service Support	Matthew Raubinger	(586) 282-1430
PEO Intelligence, Electronic Warfare & Sensors	Todd Simkins	(443) 861-7823
PEO Soldier	Kristin McKenna	(703) 704-2096

DEPARTMENT OF THE ARMY PROPOSAL CHECKLIST

This is a Checklist of Army Requirements for your proposal. Please review the checklist to ensure that your proposal meets the Army SBIR requirements. You must also meet the general DoD requirements

specified in the solicitation. **Failure to meet these requirements will result in your proposal not being evaluated or considered for award**. Do not include this checklist with your proposal.

1. The proposal addresses a Phase I effort (up to **$100,000** with up to a six-month duration) AND (if applicable) an optional effort (up to **$50,000** for an up to four-month period to provide interim Phase II funding).

2. The proposal is limited to only **ONE** Army Solicitation topic.

3. The technical content of the proposal, including the Option, includes the items identified in Section 5.4 of the Solicitation.

4. SBIR Phase I Proposals have 4 sections: Proposal Cover Sheets, Technical Volume, Cost Volume and Company Commercialization Report. The Technical Volume has a 20-page limit including, but not limited to: table of contents, pages intentionally left blank, references, letters of support, appendices, technical portions of subcontract documents [e.g., statements of work and resumes] and all attachments). However, offerors are instructed to NOT leave blank pages, duplicate the electronically generated cover pages or put information normally associated with the Technical Volume in others sections of the proposal submission as THESE WILL COUNT AGAINST THE 20 PAGE LIMIT. ONLY the electronically generated Cover Sheets, Cost Volume and Company Commercialization Report (CCR) are excluded from the 20-page limit. As instructed in Section 5.4.e of the DoD Program Solicitation, the CCR is generated by the submission website, based on information provided by you through the "Company Commercialization Report" tool. Army Phase I proposals submitted over 20-pages will be deemed NON-COMPLIANT and will not be evaluated.

5. The Cost Volume has been completed and submitted for both **the Phase I and Phase I Option** and the costs are shown separately. The Army prefers that small businesses complete the Cost Volume form on the DoD Submission site, versus submitting within the body of the uploaded proposal. The total cost should match the amount on the cover pages.

6. Requirement for Army Accounting for Contract Services, otherwise known as CMRA reporting is included in the Cost Volume (offerors are instructed to include an estimate for the cost of complying with CMRA).

7. If applicable, the Bio Hazard Material level has been identified in the Technical Volume.

8. If applicable, plan for research involving animal or human subjects, or requiring access to government resources of any kind.

9. The Phase I Proposal describes the "vision" or "end-state" of the research and the most likely strategy or path for transition of the SBIR project from research to an operational capability that satisfies one or more Army operational or technical requirements in a new or existing system, larger research program, or as a stand-alone product or service.

10. If applicable, Foreign Nationals are identified in the proposal. An employee must have an H-1B Visa to work on a DoD contract.

Army SBIR 13.2 Topic Index

A13-070 TITLE: In-Plane Conductivity Improvement to Fiber Reinforced Composite Materials

TECHNOLOGY AREAS: Materials/Processes

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 5.4.c.(8) of the solicitation.

OBJECTIVE: Develop a lightweight solution to improve the in-plane thermal conductivity of carbon fiber reinforced polymer composite materials that is either directly integrated into the material, co-cured within the fabrication process of a composite structure, or secondarily bonded to the structure without significantly affecting the structural capabilities of the material.

DESCRIPTION: Fiber reinforced polymer composites exhibit high specific strength and stiffness making them extremely attractive in many structural applications. Unfortunately, for applications such as missile airframes and guidance electronics units, the insulative nature of the polymer matrix can cause issues due to the packaging of high power electronics. As the state of the art in missile electronics continues to evolve, it becomes increasingly important to be able to remove heat from the structure to ensure electronics survivability. Conventional aerospace materials such as aluminum offer great advantages with respect to thermal management due to their high isotropic thermal conductivity (usually in excess of 130 W/m-°C) and favorable specific heat capacity. Carbon fiber reinforced epoxy composites offer a stronger, lightweight, corrosion resistant structural alternative to aluminum; however, the aforementioned thermal properties make them unfavorable in applications requiring thermal management. The goal of this three-phase SBIR process, therefore, is to address the thermal limitations of composites and deliver a novel, lightweight material solution to improving the in-plane thermal conductivity of composite structures as a potential replacement for aluminum missile structures.

The nature of this application involves thin skin composite structures (up to 0.1" thick) where the fibers are oriented in the x-y direction. It has been shown that moderate increases to the in-plane thermal conductivity can have drastic effects on the overall ability of the structure to manage waste heat loads (often in excess of 50 W); this is largely due to the large surface areas used as convective surfaces. This topic addresses one of the top 5 Army Science and Technology Challenges of overburdened soldiers that must carry heavy close combat weapon systems. Man-portable systems such as Javelin benefit from lightweight and reduced volume composite structures. There is an immediate need for lightweight advanced material systems that lessen the weight on burdened soldiers, while still providing enhancements to structural performance and maintaining effective thermal management capability.

PHASE I: Identify potential approaches to integrating high in-plane thermal conductivity into composite structures. Assess feasibility of various methodologies from a fabrication standpoint. Develop analytical tools to model various methodologies and understand them from a performance standpoint. Demonstrate in-plane thermal conductivity enhancements that exceed 10 x the conductivity of the composite baseline (at ~5 W/m-°C) with less than 5 % degradation in tensile and compressive strength values of composite baseline using coupon level experiments.

PHASE II: Develop, test and demonstrate a prototype composite missile airframe structure, of the geometry dimensions provided by the customer, possessing high in-plane thermal conductivity. Test the thermal and structural performance of the structure using stimulant missile electronics to represent waste heat loads and representative thermal and mechanical system configurations to be provided by the customer. Test the performance under relevant environmental conditions. Demonstrate improvements in thermal performance over structurally equivalent aluminum cylindrical structures.

TRL: (Technology Readiness Level) TRL Explanation Biomedical TRL Explanation
TRL 6 - System/subsystem model or prototype demonstration in a relevant environment

PHASE III: Weight reduction and affordable manufacturing processes is of great importance in many aviation and missile structures. The awardee will deliver a material solution that can be easily integrated into any carbon composite structure using conventional composite processing approaches including, but not limited to, filament

winding, hand layup, and tube rolling. This will enable transition of the technology to defense and aerospace users. This is considered a pervasive technology and can be applicable to future Army weight reduction efforts for systems with thermal management issues including TOW, Javelin, JAGM, and multiple unmanned and manned aerial vehicle platforms.

REFERENCES:
1) Springer, G. S., S.W. Tsai, Thermal conductivities of unidirectional materials, Journal of Composite Materials, v. 1, n. 2, p. 166-173, 1967.

2) Rolfes, R., U. Hammerschmidt, Transverse thermal conductivity of CFRP laminates: A numerical and experimental validation of approximation formulae, Composites Science and Technology, v. 54, p. 45-54, 1995.

3) Pilling, M. W., B. Yates, M.A. Black, P. Tattersall, The thermal conductivity of carbon fibre-reinforced composites," Journal of Materials Science, n. 14, p. 1326-1338, 1979.

4) Owens, A.T., Thermal management in fiber reinforced composite applications, Proceedings of the 2008 International Conference on Composite Materials, Edinburgh, UK, 2008.

KEYWORDS: Fiber Reinforced Composites, Thermal Management, In-plane Thermal Conductivity, Cylindrical Composite Structures, Convective Surfaces, Lightweight, Advanced Material

A13-071 TITLE: Low Cost Finishing of Optical Ceramic Domes with Embedded Grids

TECHNOLOGY AREAS: Materials/Processes

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 5.4.c.(8) of the solicitation.

OBJECTIVE: The goal of this topic is to develop methods or techniques that will reduce the fabrication costs of optical ceramic domes containing embedded grids.

DESCRIPTION: The Army has been developing large hemispherical domes for tri-mode seeker applications in current and future missile systems. The domes are made from hard optical ceramic materials such as aluminum oxynitride (ALON) and spinel. Several shielded designs incorporate metallic grids embedded within the optical ceramic material. With the tri-mode dome, the location of the embedded grid needs to be held to tight tolerance, plus or minus 1 mil, with respect to both the concave and convex surfaces. While finishing costs of traditional domes can approach half of the overall cost of the dome, finishing of the tri-mode dome could be significantly more expensive. This is due to the additional time and effort needed to maintain the position of the grid throughout the finishing process. It may be possible to compensate for the additional finishing time by reducing time elsewhere in the process. This could be from faster material removal, automated finishing, integrated grid tracking, or any other reasonable method that will save time and reduce cost. A significant reduction in the cost of optical finishing these domes could save the Department of Defense millions of dollars in procurement costs. The goal for this topic is to reduce the finishing cost by 50% which equates to one forth reduction in the overall dome cost.

PHASE I: Evaluate the feasibility of reducing the cost of optical fabrication for ceramic gridded domes by a factor of two over tradition dome finishing. The study should include an analysis supporting the projection of a 50% reduction in optical fabrication costs for a full size gridded dome, and discuss how to achieve the tolerances goals in the Phase II. The evaluation should also include a demonstration of the fabrication technique on both flat coupons and curved surfaces. Biaxial flexure strength measurements should be performed on the polished flats to demonstrate that the new techniques do not compromise strength. The cost of the ceramic blanks should be included as part of the proposal.

PHASE II: Use the techniques developed in Phase I to demonstrate a minimum 50% reduction in optical fabrication costs for a nominally seven inch diameter ceramic dome with embedded grid. The dome surfaces will be corrected

to meet the 1/4 wave transmitted at 632.8 nanometers, center thickness to +/- 0.001 inches, radii center to center at +/- 0.0005 inches, and grid position to +/- 0.001 inches. The target radii, thickness, and grid position will be provided by the Army at the beginning of this phase. The gridded ceramic dome blanks should be included as part of the cost proposal either by procurement or by partnering with a dome manufacturer.

PHASE III: Scale the processes developed in this effort to demonstrate production quantities and/or rates. This will be an enabling technology for future systems requiring the highest quality optics at an affordable price. Optical ceramics are used for a variety of missile domes and sensor windows. A factor-of-two reduction in the optical fabrication costs would result in significant savings for the Department of Defense. A small percentage of work at optical finishing house is government; therefore the techniques developed in this effort would most likely be used to process commercial orders for high quality optics as well.

REFERENCES:
1] Harris, Dan, "Material for Infrared Windows and Domes," ISBN 0-8194-3482-5, SPIE Press, 1999.

2] Warner, Charles, et al, "Characterization of ALON Optical Ceramic," Window & Dome Technologies and Materials IX, Proceedings of the SPIE, Orlando, FL, March 2005.

3] Jian Yu, et al, "Processing Method and Process Modeling of Large Aperture Transparent Magnesium Aluminate Spinel Domes," Defense, Security, and Sensing, Proceedings of the SPIE, Orlando, FL, April 2009.

4] A. LaRoche, et al, "Manufacturing issues for polycrystalline transparent spinel domes," Defense, Security, and Sensing, Proceedings of the SPIE, Orlando, FL, April 2009.

5] Lee M. Goldman, et al, "ALON Optical Ceramic Transparencies for Window, Dome, and Transparent Armor Applications," Window and Dome Technologies and Materials XII, Proceedings of the SPIE, Orlando, FL, April 2011.

KEYWORDS: optical ceramics, infrared domes, optical fabrication, ALON, spinel

A13-072 TITLE: Non-Fouling Water Reuse Technologies

TECHNOLOGY AREAS: Materials/Processes

ACQUISITION PROGRAM: PEO Combat Support & Combat Service Support

OBJECTIVE: Develop a non-fouling water reuse technology to achieve field-potable water quality from gray water influent.

DESCRIPTION: Supply of water for potable and non-potable uses at contingency operating bases (COBs) represents a significant logistical and economic burden for the Army. To help alleviate this burden, on-site water treatment with reverse osmosis (RO) membrane technology has been applied for tactical water production and more recently for water reuse. Benefits of RO membrane technology include its ability to remove a wide variety of contaminants and drastically reduce total dissolved solids (i.e., salts) in a single treatment step. However, RO membrane technology is susceptible to foulants that decrease water production and energy efficiency. As a result, pretreatment systems such as conventional treatment processes (coagulation, flocculation, sedimentation, and filtration) or low-pressure membrane filtration (microfiltration, ultrafiltration) are required. While generally effective when applied with careful operator attention, these processes are not ideally suited for the variability in influent water quality and operational schedule in contingency operating environments. Many of the systems also require routine maintenance, such as cleaning of foulants from membranes, and replacement of critical system components, which represents additional operational burden.

To support the Army's goal of reducing water demand at contingency operating bases (COBs) by 75%, under Science & Technology Challenge Area 4a, SBIR proposals are sought that will further improve water reuse capabilities at COBs. Specifically, the development of water reuse technology that is not susceptible to performance degradation due to fouling, regardless of influent water quality or system operation schedule, is desired. Innovative

systems that use alternative approaches to reverse osmosis technology but still produce the same quality of product water are of interest. Systems should not require extensive pretreatment (beyond roughing filtration), nor should they require extensive post-treatment (beyond granular activated carbon polishing and chlorination).

Systems should be designed and tested against the following metrics:
1) Ability to produce field potable quality water from gray water sources.
2) Ability to produce water with less than 500 mg/L total dissolved solids.
3) Non-fouling (operator-mediated cleaning frequency greater than monthly, and no need for replacement of components due to fouling).
4) Autonomous operation.
5) Maintenance requirement of less than 30 min/week.
6) Energy consumption less than 20 kWh/kgal product water.
7) Water recovery of 90% or more.
8) Physical footprint of less than 1 cubic meter per 1 kgal/day product water.

While the intended reuse application would likely not be human consumption, potable water quality levels are still desirable for other human-contact reuse applications such as showering. Current Army field policy allows for the recycling of gray water from laundry and shower facilities for shower use.1

PHASE I: Phase I should include a bench scale demonstration of the water treatment performance and a detailed engineering estimate of the energy efficiency, maintenance requirements, and physical footprint at design scales. Water treatment performance testing shall be performed over a period of at least 3 months in a manner consistent with published gray water treatment testing standards.2 Challenge water formulations shall be designed using a standard base formulation and augmented to reflect water quality conditions expected in contingency operating environments. Engineering estimates of energy efficiency, maintenance requirements, and physical footprint shall be made for design case of 10 and 20 kgal/day.

Phase I metrics shall include:
1) Demonstration of sodium chloride removal efficiency > 99%
2) Demonstration of BOD reduction to levels below 10 mg/L
3) Demonstration of total coliform bacteria removal to 0 cfu/100 ml
4) Projected energy efficiency of < 20 kWh/kgal at 10 kgal/day design scale
5) Projected footprint of less than 10 cubic meters at 10 kgal/day design scale

PHASE II: Phase II should include design, assembly, and testing of a 1 kgal/day system. The first year should focus on design and assembly of the prototype. Designs shall be fully drafted using professional grade drafting software, with all parts specified in terms of size, material, and source. Systems shall be assembled and flow tested using clean water by the end of the first year of Phase II funding. The second year of Phase II should focus on testing the system at 1 kgal/day in a simulated relevant environment. Systems should be tested over a 6-month period using a test protocol consistent with the NSF 350 testing standard.2 Challenge water formulations and system operation schedule shall be representative of contingency operating environments. Water treatment performance, energy consumption, and maintenance requirements shall be documented in detail.

Phase II products shall include:
1) A water purification system that is less than 10 cubic meters in size and produces 10 kgal/day, along with detailed specifications and drawings
2) A report detailing water treatment performance, energy consumption, and maintenance requirements over a 6-month test period

Phase II metrics include:
1) Demonstration of maintenance intervals of at least one week and less than 30 minutes in duration (each).
2) Demonstration of sodium chloride removal efficiency > 99%, BOD reduction to levels below 10 mg/L, and total coliform removal/inactivation to less than 2 cfu/100 ml.
3) Demonstration of energy efficiency of < 20 kWh/kgal.

PHASE III: Military applications for a system that meets the metrics described herein may include water reuse in contingency operating environments; water reclamation at installations; distributed water reuse systems at installations; and aquifer recharge at installations. Additional commercial markets may include: household water

purification and reuse systems; municipal water and wastewater treatment; recovery of water during oil and gas production operations, such as fracking; and industrial water treatment.

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http://phc.amedd.army.mil/PHC%20Resource%20Library/Non-Potable%20Water%20Reuse%202011.pdf

2) National Sanitation Foundation. Onsite Residential and Commercial Reuse Treatment Systems. July 2012.

KEYWORDS: Gray water, grey water, wastewater, water treatment, water purification, water reuse, water reclamation

A13-073 TITLE: Developing Methods for Positional Accuracy of High Resolution Satellites

TECHNOLOGY AREAS: Electronics

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 5.4.c.(8) of the solicitation.

OBJECTIVE: Increase the pointing accuracy of the Kestrel Eye satellite to 10 meters or less.

DESCRIPTION: The United States has very highly capable imaging satellites built by both Government and commercial organizations. However these satellites are expensive, limited in number and there is competition for their use. The Army desires to increase the persistency of imagery coverage, have tasking controlled directly by lower echelons and have imagery delivered from the satellite directly to the tasking forces. There is also a desire to be able to share this imagery with Allies and coalition partners in near real-time. This imagery is used for battlespace awareness purposes, as opposed to technical intelligence. As a result, medium to lower resolution imagery is acceptable if delivered within a few minutes of tasking. The miniature electronics revolution that has made smart phone possible is being extended into space. Very small satellites offer an affordable solution to increasing the number of available apertures on orbit in order to achieve persistent coverage for low organizational levels of mission command.

Kestrel Eye is an imaging microsatellite capable of producing visible imagery at 1.5 meter ground sample distance resolution when the satellite is pointed at nadir. Design trades are in work to add an infrared and/or hyperspectral imaging capability. Images that cover an area 5.8 by 3.8 kilometers are transmitted in jpg format with a GPS tag indicating the ground latitude and longitude of the image. The Block II Kestrel Eye design weighs between 22 and 25 kilograms. The satellite has a GPS receiver, a star tracker, and reaction wheels to control pointing. The estimated ground location accuracy of the image is currently about 60 meters.

Images from Kestrel Eye will be used to detect the presence of enemy activity, to include the implanting of Improvised Explosive Devices (IEDs). Images will also be used to assist in maintaining perimeter security at our forces' forward operating locations. Some of these images will be in areas where there are insufficient terrain features to precisely locate objects in the frame. This drives the need for improved pointing accuracy. The objective of this SBIR is to improve the pointing accuracy or the ground location accuracy of imagery collected by the Kestrel Eye microsatellite to much better than 60 meters.

The technical challenge of this SBIR is that the small size of Kestrel Eye limits the size, weight and power consumption of satellite position sensors, control electronics and the incorporation of position knowledge into the image data being transmitted. Although the satellite is capable of taking five pictures per second, the S-Band downlink rate of 1 Megabit/second limits transmissions to one image approximately every 10 seconds. In addition, the satellite will be flying at a nominal altitude of 450 kilometers, which results in short overhead passes and rapidly changing angles from the telescope to the target site. Despite the extraordinary investment the commercial electronics industry has made in miniaturization and the success achieved with smart phones and other personal

electronic devices, this revolution has only just begun to extend into space. The purpose of this SBIR is to accelerate that extension and optimize the application of these technologies into the Kestrel Eye satellite form factor to improve position knowledge of the image from 60 meters to 10 meters or less.

PHASE I: Determine the technical feasibility of using miniaturized position sensors, control electronics and data transmission systems to improve the pointing accuracy of Kestrel Eye from 60 meters to 10 meters or better. Perform end-to-end systems engineering to ensure all of the components work in harmony to achieve the desired performance. This research should also present information on a realistic design that would fit within the weight, power and physical space dimensions of the 25 kilogram satellite.

PHASE II: Leveraging the results from Phase I, develop a prototype system for Kestrel Eye that can be used in ground verification testing. Simulated orbital conditions will be fed into the sensors and pointing accuracy will be extrapolated based upon test measurements.

PHASE III: The end state for this R&D will be an enhanced Kestrel Eye imaging microsatellite that will have provide imagery with greatly improved positional accuracy. This capability will improve the operational awareness of units in the field and will support mission command and intelligence operations. The persistent coverage provided by these enhanced satellites will improve soldier survivability and lethality.

Interest in microsatellite imaging technology is rapidly increasing both for National Aeronautics and Space Administration (NASA) as well as commercial applications. Imaging microsatellites are being examined for environmental monitoring as well as use in humanitarian assistance and disaster relief.

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1) US ARMY NANOSATELLITE TECHNOLOGY DEMONSTRATIONS, by John R London III, A. Brent Marley, US Army Space and Missile Defense Command,
http://www.armyscienceconference.com/manuscripts/B/BP-013.pdf

2) KESTREL EYE, Visible Imagery Nanosatellite Technology Demonstration,
www.smdc.army.mil/FactSheets/KestrelEye.pdf

3) Space Enabled Effects for Military Engagements (SeeMe),
http://www.darpa.mil/Our_Work/TTO/Programs/Space_Enabled_Effects_for_Military_Engagements_(SeeMe).aspx

4) "The First US Army Satellite in Fifty Years: SMDC-ONE First Flight Results" by John R. London, David J. Weeks, and A. Brent Marley. (25th Annual AIAA/USU Conference on Small Satellites, 2011)

5) Aviation Week (27 August 2012), "New Army Frontier: US Army Hopes To Break High Launch Cost Barrier to Build Its Own Tactical Satellites."

KEYWORDS: Unattended Ground Sensor (UGS), Imaging microsatellite, SeeMe DARPA program, Kestrel Eye

A13-074 TITLE: Data Exfiltration of Unattended Ground Sensor Data using a 3U Cube Satellite

TECHNOLOGY AREAS: Electronics, Space Platforms

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 5.4.c.(8) of the solicitation.

OBJECTIVE: Increase the data rate and signal strength capabilities for exfiltrating signals from Unattended Ground Sensors (UGS) using a 3 Unit (3U = 10x10x34 centimeter) cube satellite.

DESCRIPTION: The US Army is increasingly relying on Unattended Ground Sensors (UGS) in current military operations. For example, the number one cause of soldier deaths and injuries in current military operations is the

Improvised Explosive Device (IED). To combat this threat Unattended Ground Sensors (UGS) are placed to detect enemy movements, including enemy digging to emplace the IEDS. More broadly, the US Army is using UGS to assist in force protection of military outposts – for example, perimeter security. Thus, UGS are being used to detect enemy activity as these units attempt to infiltrate friendly positions.

In addition to the seismic/acoustic sensors mentioned above, the US Army is actively developing new generations of wireless CBR (Chemical-Biological-Radiological) sensors to monitor the physical environment for combat/logistics or HADR (Humanitarian Assistance/Disaster Relief) operations. These UGS are deployed in a wireless network to cover a very large area and reporting data in real-time to a remote command center.

Data from UGS sensors must be collected, processed, and warnings disseminated to the Soldiers in harm's way. Currently, the collection of sensor data represents a logistical challenge. UGS are battery powered with limited radio transmission range. To collect these signals Soldiers may have to expose themselves to incoming fire or hazardous CBR agents or they may give away their position or intentions in order to get close enough to the UGS to receive their signals.

New technologies need to be investigated and developed to solve this logistical challenge. A secure and covert way of extracting the UGS signals is via satellite. The miniature electronics revolution of recent years has enabled smart sensing devices to come in a very small packages, and smart phones to have incredible processing power. This electronics revolution is being extended into space. Nanosatellites are routinely being launched. One type of nanosatellite is the 3U (3 Unit) cube satellite. When folded in launch configuration they measure only 10x10x34 centimeters and weigh about 5 kilograms. In December 2010, limited demonstrations were conducted with the Army's SMDC-ONE cube satellite in orbit where data from an UGS was successfully collected, transmitted to the cube satellite through a NEXUS gateway and then relayed to a ground station. While this limited demonstration was successful, there are still major problems to solve.

This SBIR is designed to increase the data rate and radio frequency sensitivity of this data exfiltration capability. UGS come in a variety of sizes and capabilities. Some are simple pressure sensors that transmit a limited amount of information at a very low data rate. Other sensors measure a number of parameters and require higher data rates. All have relatively low transmit power levels, and by design have less than optimum performance antennas in order to reduce their visual profile. These limitations are a challenge to successful signal collection. This topic specifically is targeting enhancements to the cube satellite to improve communications; enhancements to the UGS devices are out of the scope of this SBIR topic.

Most of the wireless UGS are designed to be operational in an extended amount of time without changing the batteries, the primary power source. Thus all the electronics components, especially the communication subsystem, are very energy efficient. The internal software regulates the radio power consumption through the data acquisition and reporting rate.

The technical challenge of this SBIR is that the small size of the cube satellite means that the receiver and antenna are also limited in size, weight and power consumption. Despite the extraordinary investment the commercial electronics industry has made in miniaturization and the success achieved with smart phones and other personal devices, this revolution has only just begun to extend into space. The purpose of this SBIR is to accelerate that extension and optimize the application of these technologies into the 3U cube satellite form factor.

PHASE I: Determine the technical feasibility of using sensitive cube satellite receivers and an improved antenna system to collect UGS data. Perform end-to-end systems engineering and link calculations to determine maximum data rates and optimal frequencies for UGS collection. Use specifications of actual UGS either in the Army inventory or which will be in the Army inventory in 2 years or less. This research should also present information on a realistic design that would fit within the weight, power and physical space dimensions of a 3U cube satellite.

This design should also include an approach to develop small nano-stat compatible ground transceiver components that could fit into the UGS wireless network, either as a stand-alone external or an internal circuit board, plus omnidirectional antenna. The data communication between ground and space is flexible and programmable depending on the nature of the UGS and the ground operation.

PHASE II: Leveraging the results from Phase I, develop a prototype receiver and antenna for a cube satellite that is optimized for a particular type of UGS (to be decided jointly between the Government and the contractor in Phase

I). Provide practical implementation demonstrating the acquisition UGS data over a variety of orbit altitudes and antenna receive angles. Address a concept of operations where multiple cube satellites in Low Earth Orbit that are not cross-linked successively pass over the UGS to collect and relay their data.

PHASE III: The end state for this R&D will be an enhanced 3U cube satellite that will have robust communications capabilities with US Army UGS. This capability will improve the operational awareness of units in the field and will support mission command and intelligence operations. The persistent coverage provided by these enhanced satellites will improve soldier survivability and lethality.

The 3U cube satellite standard has been promulgated by California Polytechnic Institute and numerous other organizations. The National Aeronautics and Space Administration (NASA) is sponsoring launches for experimental 3U payloads on a competitive basis. Higher data rates and signal sensitivity in a 3U form factor would broadly benefit the academic as well as the scientific community.

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http://www.armyscienceconference.com/manuscripts/B/BP-013.pdf

2) USASMDC/ARSTRAT: Fact Sheet SMDC-One (Nanosatellite Technology Demonstration)
http://www.smdc.army.mil/FactSheets/SMDC-One.pdf

3) US Army Space and Missile Defense Command, Operational Nanosatellite Effect (SMDC-One), Program Status, CubeSat Workshopr 2009
http://mstl.atl.calpoly.edu/~bklofas/Presentations/DevelopersWorkshop2009/5_Missions_1/4_Graham-SMDC.pdf

4) ERDC-TEC AQUAPATH: biological sensor fact sheet
http://erdc.usace.army.mil/product-tec/aquapath/

5) ERDC-TEC SilverHawk: chemical, biological and rad sensor fact sheet

6) ERDC-TEC Ground Structure sensor for counter IED fact sheet

7) TARDEC Water Quality sensor fact sheet

KEYWORDS: Unattended Ground Sensor (UGS), Nanosatellite, 3U (three unit) cube satellite, SMDC-ONE (Space and Missile Defense Command - Operational Nanosatellite Effect)

A13-075 TITLE: Geospatially-networked Sensors for Heavy Metal Detection in Surface Water and Soil

TECHNOLOGY AREAS: Electronics

OBJECTIVE: Development of small, portable geospatially-enabled mesh-networked sensors for dynamic detection of heavy metals in water and soil. The objective is to develop sensors that are capable of being integrated into existing Engineering Research and Development Center (ERDC) sensor network specifications in order to detect, monitor and report concentrations of heavy metals in surface waters and soils. Elements of interest include, but are not limited to: lead, arsenic, chromium, mercury, and cadmium. Surface waters represent the main source water for deployed personnel and heavy metals are not completely removed by filtration treatment technologies currently in use by the Army. Such technology is also needed for environmental monitoring and water quality analysis. Soils, on the other hand, are the major sink of heavy metals released into the environment by anthropogenic activities and the presence of such contaminants poses risks to human health through contamination of ground water or reducing land usability for agricultural production.

DESCRIPTION: There is a critical need to assess the water and soil conditions of operating bases for soldier safety and restoration efforts. Assessment of heavy metal concentrations at potential operating sites would help in determining feasibility of proposed operation areas, limit soldier exposure to heavy metal toxins, and provide an

ecological record of the conditions before US activities. The post-use assessment of a site would provide financial and political insurance from costly remediation of preexisting conditions, political fallout over inappropriate US land usage and a record physical of the environment after US usage. The current techniques of heavy metal detection include Atomic Absorption Spectrometry (AAS) and Inductively Coupled Plasma-Mass Spectrometry (ICPMS) however, such methods require costly equipment which is not practical to use in the field, also produce gaseous waste products that can be difficult to dispose of, and can only be operated by personnel having specialized training. Currently, electrochemical methods are showing promise for heavy metal detection, but have been performed in ideal laboratory conditions and in isolation from complex matrices. X-Ray fluorescence is highly effective and portable but requires expensive sealed radiation sources and large energy requirements. A need exists for an inexpensive and deployable sensor to assess heavy metal conditions from soil and water samples. Such a device could have automated sampling or require a minimal of human training for loading of samples. The target sensitivity would be determining concentrations of less than 1 part per million (ppm) and have very low to no reagent requirements on a daily basis. Examples could be usage with only a weekly re-supply of liquid, chemical, or battery consumables. The desired sensor will be able to be integrated into a larger, GPS-enabled wireless reporting system of meshed networked sensors for automated sample data retrieval and geo-spatial mapping.

PHASE I: Construct a functional concept design capable of detecting 5 simultaneous targets from the list above, at 80% of required limit in under 10 minutes. Design should include plans and flexibility for mesh network integration, sample preparation, and military ruggedization.

PHASE II: Develop a prototype device which integrates into an existing mesh network and can detect 5 simultaneous targets at concentrations of less than 1 part per million (ppm). Provide calibration data for single and multiple targets, power usage information, and consumables that can withstand long shelve lives, temperature extremes, and rough handling.

PHASE III: The intended device has application beyond military use and can be applied for environmental monitoring, remote site monitoring where with limited man power and/or communications, and for disaster response.

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1. Ruana, R.A. and Okieiman, F.E., 2011. Heavy metals in contaminated soils: a review of sources, chemistry, risks, and best available strategies for remediation. ISRN Ecology.

2. TG 230 – Environmental Health Risk Assessment and Chemical Exposure Guidelines for Deployed Military Personnel, June 2010.

3. Turdean, G.L., 2011. Design and development of biosensors for detection of heavy metal toxicity. International Journal of Electrochemistry.

4. Grieshaber,D., MacKenzie, R., Voros, J., and Reimhult, E., 2008. Electrochemical biosensors - sensor principles and architectures. Sensors (8): 1400 - 1458.

KEYWORDS: Heavy metals, geospatial, mesh network, remote, wireless, automated

A13-076 TITLE: Flexible, Stretchable, and Hyperelastic Photovoltaic Generating Textile

TECHNOLOGY AREAS: Materials/Processes

OSBJECTIVE: Develop a robust, flexible, stretchable and hyperelastic, efficient, photovoltaic textile (“solar textile”) suitable for incorporation in both infrastructure and weapon systems.

DESCRIPTION: Energy solutions for forward basing and associated war fighting operations are moving toward hybrid and integrated energy/power systems. Through the increased use of indigenous energy sources dependence on traditional sources can be supplemented, thus reducing the operational logistics/supply burden. Additionally, this helps free up resources to further support mission. This topic specifically focuses on the development of a flexible, stretchable, and hyperelastic photovoltaic textile that is suitable for integration into multiple applications. The

textile must be able to produce electricity using sunlight, be flexible/stretchable/hyperelastic and conformal, be robust and able to survive harsh treatment and a range of natural environments, and be at least efficient enough to economically justify widespread use. This work will require the development/improvement of the photovoltaic textile, and incorporation into at least one prototype application. Within the EQ/I business area infrastructure applications for forward basing will be favored. However, potential applications for use with weapon systems are also widespread and will need to influence dual use related development decisions.

PHASE I: Develop and fabricate at least ten flexible/stretchable/hyperelastic photovoltaic fabric power solution prototypes. The prototypes shall have an unstretched macro-scale size with a surface area within the range of 25 to 1,000 cm2. The minimum current output for simulated natural conditions shall be 0.5 mA/cm2 (unstretched). More is better. While small scale, multi-separate, rigid unit attachment to a flexible substrate is an approximate solution, a lighter and fully integrated (i.e., all definable continuous and contiguous regions and sub-regions able to stretch) is strongly preferred. Characterization shall include quantitative characterization of stretchable characteristics, and electrical contact durability against rapid fatigue failure. Produced flexible samples shall be characterized for performance (to include conversion efficiency and durability). Identical samples shall also be provided for testing and evaluation. The Phase I design will be prototyped and further evaluated and improved in Phase II. Phase I reporting shall include the textile design's scientific and technical merit and feasibility, while also addressing the overall business case viability. Business considerations typically include production scale up plans, projected costs per unit area as produced, and all within the context of one or more projected markets.

PHASE II: Produce flexible/stretchable/hyperelastic photovoltaic textile material with improved properties as compared to Phase I. The current output shall be within the range of 1 - 5 mA/cm2 (unstretched) or better. Proceed to integrate this material, along with energy storage capability, into a chosen infrastructure prototype application (e.g., integrated balloon or inflatable kite PV, parachutes/parasails, protective and charging covers, inflatable domed structures with integrated PV, etc.). Characterize the infrastructure prototype performance. Quantitative characterization testing and evaluation is to include at minimum: energy and power outputs, reliability, durability, quantitative stretchable capabilities, systems integration effectiveness and interoperability (as applicable), and all for a variety of expected environments. The ability to provide effective, undiminished power production for a minimum of two years is also required. Additional testing and evaluation of key prototype characteristics is also encouraged and will be factored into the selection evaluation process. The use of CBITEC (Contingency Basing Integration Technology Evaluation Center, located at Fort Leonard Wood, MO) or similar real-world test environments for final prototype evaluation will be required.

PHASE III DUAL USE APPLICATIONS: Various military and civilian applications/use of this technology are envisioned. Commercialization could be through direct sales and/or via sub-component supply to larger integrated system suppliers. Wider commercial applications for infrastructure use could involve A/E (Architect and Engineer) firm specification, inclusion in design guides and criteria, or other innovative and duel use applications.

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3) Lee, J., Wu, J., Shi, M., Yoon, J., Park, S., Li, M., Liu, Z., Huang, Y., Rogers, J., 2011, "Stretchable GaAs Photovoltaics with Designs that Enable High Areal Coverage," Advanced Materials, 23, pp. 986-991.

4) Kylberg, W., Araujo de Castro, F., Chabrecec, P., Sonderegger, U., Tsu-Te Chu, B., Nuesch, F., Hany, R., 2011, "Woven Electrodes for Flexible Organic Photovoltaic Cells," Advanced Materials, 23, pp. 1015-1019

5) Bedeloglu, A., Demir, A., Bozkurt, Y., Sariciftci, N., 2009, "A flexible Textile structure based on polymeric photovoltaics using transparent cathode," Synthetic Metals, 159, pp. 2043-2048.

KEYWORDS: textile, PV, electrical generation, flexible, stretchable, hyperelastic, durability, fatigue, energy storage

A13-077 TITLE: Detection and Classification of Micro-Terrain Features by Surface Roughness and Landform Discontinuities from Small-Footprint, Discrete-Return Airborne LiDAR Data

TECHNOLOGY AREAS: Electronics

OBJECTIVE: To develop an integrated software application that processes small-footprint discrete airborne LiDAR (Light Detection and Ranging) data of terrain for detection and classification of micro-terrain features defined by surface discontinuities and various conditions of surface roughness.

DESCRIPTION: Small-footprint, discrete-return LiDAR (Light Detection and Ranging) sensors have become increasingly useful for natural resource management and for enhanced military knowledge of the Battlespace for surveillance and mission planning. These airborne laser scanning systems have been successfully applied to terrain modeling and analysis in such diverse applications as determining forest structure, extraction of urban features, and tracking changes in dynamic coastal environments. High point densities produced by modern commercial scanning systems and high precision Global Positioning System (GPS) data allow for high accuracy in mapping ground features and in representing vertical structure. Frequent scanning missions can reveal newly-formed features or recently changes in their appearance. This capability has not yet been fully exploited for accurately capturing the position, extent, and surface structure of micro-terrain features that often escape mapping efforts. Higher-fidelity knowledge of small-scale terrain irregularities would better inform efforts to map obstacles to cross-country movement and improve mobility models in difficult terrain for military and emergency planning.

The high-frequency return pulse information from scanning systems can be processed into point clouds that model the reflective surfaces of ground features as well as the internal structure of vegetative canopies. In addition, LiDAR pulse return positions can be interpolated to create a digital elevation model (DEM). Non-ground pulse returns can be filtered to create a digital terrain model (DTM) of the ground surface. However, in spite of high sampling rates, LiDAR pulse footprints are non-contiguous, resulting in under-sampling of surface features. Yet small-scale terrain features with discontinuous elevation characteristics have been detected and mapped from airborne LiDAR scanning data in the absence of dense forest overstory. This topic seeks to develop a capability to process and interpret small-footprint LiDAR data for the detection of small-scale terrain surface discontinuities as micro-features in open areas and under canopy with elevation differences on the order of a few meters or less, and to categorize terrain areas defined by these features and by the degree and type of surface roughness.

The software solution should be able to distinguish vegetated areas from essentially non-vegetated areas. An attempt should also be made to extract the types of micro-features and areas of surface roughness described above in under-canopy settings. Terrain roughness may be described by degree (defined by mean relative elevation change) as well as texture (defined by spatial frequency or azimuthal trending of features).

The topic objective includes the ability to represent individual breaklines as linear features that help to define micro-terrain features and regions of surface roughness. The solution should also allow for the extraction and categorization of breaklines associated with man-made structures as distinct from discontinuities on the bare-earth surface. These would be converted to layers for display and analysis in a Geographic Information System (GIS) application. Return intensity values may be treated as a value-added discriminator in the extraction of surface discontinuity features or canopy height models.

The LiDAR scanning data may be analyzed as point clouds or as interpolated surface matrices in order to fully exploit the data for the identification and analysis of micro-feature breaklines and regions of surface roughness. The intent is to take full advantage of the LiDAR elevation information in the point cloud or derived gridded models to develop algorithms to detect and extract potentially subtle breaks-in-slope and their azimuthal trends, to understand their inter-relationships or connectedness in the formation of localized micro-terrain features and/or areas of surface roughness as separate features. In the case of voluminous point cloud data, compression strategies may be pursued to reduce the computational load and better facilitate data transfer and storage during processing. The contractor may take advantage of available commercial software for visualizing point cloud data and elevation models such as TerraScan or QT Modeler/Reader.

PHASE I: The contractor needs to accomplish two research goals using Government-provided small-footprint LiDAR test data. First, develop a methodology and preliminary software design that would perform detection, classification, and display of surface discontinuities and various conditions of surface roughness. Discontinuities

expressed as linear micro-terrain features might include incised stream channels, gullies, small escarpments due to the surface expression of resistant beds or movement along faults, small ridges, or other features defined by breaks-in-slope including those caused by human earth-moving activities. Unpaved roads might be characterized by edge channels or wheel-caused depressions. Regions of varying surface roughness are characterized by extended areas that contain surface discontinuities such as boulder fields, talus slopes, areas of downed trees, heavily plowed fields, or other kinds of disturbed land.

The contractor would have to state specifically in this design how he intends to perform these functions and with what (if any) COTS software. While the Army prefers that the proposed solution be compatible with ESRI (ArcGIS) or ERDAS IMAGINE, the Army will consider others.

For the second research goal, using test data provided by the Government, the contractor must evaluate his technical approach to perform the detection, classification, and display of surface discontinuities associated with micro-terrain features and various classes or conditions of surface roughness in open areas not under canopy cover. Individual extracted micro-terrain features will have a relative elevation range of 3 meters or less. Areas of surface roughness will also show a mean relative elevation change of 3 meters or less.

PHASE II: In Phase II, the contractor will complete the system design and development and integrate the processing capabilities that are defined in Phase I. The contractor will further develop and enhance capabilities developed in Phase I for 3D scene visualization and analysis of small-footprint LiDAR data for the extraction of micro-terrain and surface roughness features, and will integrate the system into an industry–standard GIS or image processing environment compatible with Army collection/dissemination programs such as Buckeye. In addition to processing open areas, the Phase II system will have the ability to perform this extraction under conditions of canopy cover in which less-than-optimal pulse energies are reaching the forest floor, and will be able to distinguish vegetated and essentially non-vegetated areas. Individual extracted micro-terrain features in open areas and in areas under canopy cover will have minimum relative elevation ranges of 1.5 meters and 3 meters or less, respectively. Areas of surface roughness will also show a minimum mean relative elevation change of 1.5 meters and 3 meters or less, in open areas and in areas under canopy cover, respectively. The system will include the ability to display mean azimuthal trending of micro-terrain features and a measure of texture for areas of surface roughness. Testing will occur with as much data as time and budgetary constraints allow. Testing will progress with data provided by the Government. The software prototype must be able to ingest and export standard data formats for imagery and vector data as functions in a 3D visualization prototype for rapid scene assessment.

PHASE III: The contractor will create a software product as a standalone application suitable for use on a 32-bit desktop machine or other service-oriented architecture and also integrate it with other commercial GIS software. The final product will be relevant to use by the Army for off-road mobility, mission planning, target detection, and possibly line-of-sight analysis by providing potentially time-sensitive and mission-critical 3D information for rapid decision-making in both open area and under-canopy environments. As timely, high-resolution LiDAR data comes into greater use and becomes more available, this technology will be directly applicable to emergency management functions important to Homeland Security such as post-natural disaster site assessment and disaster relief operations. These functions may include post-flood, post-hurricane, or tornado debris location and volume mapping. Forestry applications might include biomass assessment of forest floor debris or forest crown fuel.

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KEYWORDS: LiDAR, terrain roughness, micro-terrain, point clouds, landform discontinuities, breaklines

A13-078 TITLE: Tools for Range Maintenance/Sustainability in Support of Individual/Group Soldier Training

TECHNOLOGY AREAS: Materials/Processes

OBJECTIVE: The objective of this project is to develop a PC based computer program with GIS capability that will aid managers at test and training ranges, proving grounds, munitions production sites, and military installations in evaluating viable options for managing contamination from military test, training, and production activities.

DESCRIPTION: Military installations must address the introduction of military materials and other substances into the environment. Some are the result of military test and training activities (e.g., heavy metals and munitions constituents) and others result from routine base activities (e.g., POL, solvent, and other chemical spills). Facility managers need rapid, easy to use decision tools to determine the best approach for managing varying contaminants that could affect soil and groundwater under a varying range of geotechnical and environmental conditions.

The offeror will develop a PC based computer aid to assist managers of sites affected by various military activities. The program should be able to import GIS data layers, which could include the locations of contaminant material obtained via sampling surveys, topographic information, soil information, vegetation coverage, and aerial/satellite imagery. The program will relate soil, vegetation and topographic information to factors that affect migration of military contaminants in the environment. The program will also require importation of climatic and/or weather data to help assess potential contamination migration. The program will allow the user to develop management scenarios based on 1) removal of some or all of the contaminant, 2) development of physical barriers or topographic modification of the site to slow migration of the contaminant, or 3) the use of agents that retard movement of the contaminant. The program should maintain flexibility so that new data regarding movement and attenuation from existing contaminants can be added. In addition, the program should allow the user to add new contaminants and their properties in a straight-forward manner. The program should be easy to use by personnel with little formal scientific training. Care should be taken to produce a graphical user interface that assists the user in understanding how the program works. The program should incorporate existing models to assess lateral and vertical migration of the contaminants, as well as release into surface water and groundwater.

The program will need to be able to obtain chemical properties and data that affect contaminant migration, attenuation, treatment and management. This information can either be maintained within the program or obtained via the internet, if that information is available. Military contaminants to be included in the program include:

- High explosives: 2,4,6-trinitrotoluene (TNT), 1,3,5-Trinitrohexahydro-1,3,5-triazine (RDX), Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
- Propellants: 2,6-dinitrotoluene (DNT), nitroglycerine (NG), perchlorate, zero valent aluminum
- Penetrating metals: Depleted uranium (DU), tungsten
- Small arms metals: Lead, antimony, tungsten
- Solvents: Trichloroethene (TCE), trichloroethane (TCA)
- Perfluorinated compounds found in firefighting foams: perfluorooctanoic acid (PFOA), perfluorooctane sulfonate (PFOS)
- Petroleum, Oils, and Lubricants (POLs)
- Radionuclides

The program will need to evaluate effects of military activities on these contaminants, such as maneuver activities and repeated firing at a training range. It is expected that the program will guide the user to look for logical relationships between various contaminants. For example, the program should prompt the user to look for RDX and other high explosives if TNT is found. The program should also address costs and uncertainties associated with management methods.

PHASE I: The offeror will design architecture and integration methodology for a PC based software system in a Windows operating environment that will have the capability to import GIS data layers. The software design should have the capability to integrate quantitative environmental, geophysical, GIS, and multiple criteria decision analysis for risk management and environmental sustainability planning. The desired Phase I product is a report that describes design architecture and integration methodology needed to develop a PC based software system in a Windows operating environment.

PHASE II: Phase II shall produce a working alpha version PC based software platform utilizing the design architecture and integration methodology developed in Phase I during Phase II Year 1. The software platform should be capable of incorporating the entire range of contaminants and demonstrating the effectiveness of management methodologies to multiple installations that cover a variety of climates and soil types. The beta version software platform developed during Phase II Year 2 should have an intuitive user interface with flexible application to a range of problems typical to contaminated and disturbed site management. Beta Version software should allow implementation using libraries of models, GIS tools, and decision needs. The GIS module should implement kriging and other standard geostatistical analyses. The offer will provide a functionality demonstration of the beta version program using at least three contaminants (one contaminant at a time) with differing mobility properties (recommended contaminants are depleted uranium, RDX, and perchlorate). The offer will provide a report that documents the PC based software system; the design utilized for an integrated quantitative environmental, geophysical, GIS, and multiple criteria decision analysis for risk management and environmental sustainability planning; and results of the functionality demonstration.

PHASE III: This program will have the capability to be expanded to include a wider range of contaminants and settings, to include large contaminated sites in the civilian sections, such as landfills, chemical and petroleum refineries, large industrial complexes, etc. This type of program may have great value from a firefighting, disaster response, and home security perspective. Assessment of the modeling results for various Army (test, training, and production) and non-military sites should be conducted in Phase III. Use guidelines will be developed and tools for prioritization and decision support will be finalized in Phase III. The evaluation of the commercial product will be performed in this phase. This technology has potential commercial applications in the areas of industrial land use management (both military and civilian), stabilization and remediation strategies for varying contaminated sites, and restoration and remediation planning.

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3) Joint Effects Model (JEM). http://www.jpeocbd.osd.mil/packs/Default.aspx?pg=1701.

4) MAUDE, a Management Aid for UXO Detection Efforts software package http://el.erdc.usace.army.mil/uxo/index.html

KEYWORDS: Military contaminants, Contaminant management, GIS contaminant model

A13-079 TITLE: Convergence of sensor technologies into a tool for assessing environmental contaminants

TECHNOLOGY AREAS: Materials/Processes

OBJECTIVE: Design, develop and demonstrate the integration existing and developing methods for passive sampling, qualitative and quantitative sensing, and reporting in a single convergent environmental micro-scale

sensor. This technology should "push" for a low cost rapidly deployable sampler for contaminant assessment in water, soil, or sediment to include multiple analytes such as hydrophobic organic compounds, metals, and microbes.

DESCRIPTION: The U.S. Army requires methods for rapidly sampling and analyzing chemical and biological contaminants as part of combat mission, engineering support, or in support of humanitarian or disaster response missions (Army 2012). Sensing contaminants is required to identify potential environmental threats, be used to identify areas where contamination is most significant, and guide soldiers and technicians to areas and contaminants that require further investigation. To date, the greatest challenge for sensors has been to combine the sensing, detecting, and reporting methods into a single convergent device.

Current sensor technology research has not overcome the challenges required to field a functioning reliable and sensitive sensor to meet these requirements. These challenges include incorporating the sampler and sensing device in a platform that also includes a reporting element. For example, it is expected that advances in microelectromechanical systems (MEMS) will provide opportunities to meet this requirement. Further challenges that will require ongoing research include fouling of sensors, reliability testing, accuracy of the sensor, size/portability of the sensor, and shelf life prior to use (Farahi et al., 2012). The current approach to detecting environmental contaminants continues to be based on the collection and shipping of field collected samples to a laboratory for analysis; a task that often requires over 30 days to obtain quality usable data to guide decision making. The vision for this sensor is to combine sampling and sensing technologies such as a ruggedized MEMs device. The sensor will be used in the field and must be small (<5 cm3, <100 g), rugged, self-contained, easy to deploy, easy to interpret, and not require continuous monitoring. An ideal sensor could be deployed over longer periods of time (up to 4 weeks) and report when contamination is present.

PHASE I: Combine innovative and developed approaches for sampling and sensing contaminants. Sampling methods should consider approaches for concentrating the sample for detection through adsorption or through fluidic processes (Conder, 2003). The sensor should consider novel methods for sensing the compounds of interest in a qualitative (present/not present) or semi-quantitative (low, medium, high) manner. Demonstrate a proof of principle of the proposed design and preliminary demonstration in the laboratory. Successful demonstration will include sensing and reporting and meet the criteria listed above.

PHASE II: Develop and demonstrate a prototype that can be tested in the field and further optimized to address issues such as interference, fouling, sensitivity, error, and reporting. The sensor must be capable of detecting multiple chemicals of concern simultaneously. Demonstration should include an iteration and feedback from technical Army users of the technology. Conduct testing to demonstrate feasibility of the component for use with ongoing development of sensing kits currently being developed within ERDC.

PHASE III: The technology developed under this effort includes development for dual use applications in military and civilian areas related to environmental protection. Response to spills requires methods to determine the extent and quantity of contamination in order to make decisions about risk and direct limited resources for emergency clean up. For example, the response to the Deepwater Horizon could have been greatly accelerated and improved with real time analysis of organic contamination from the spill. Local, county, state and federal emergency spill teams can also use this capability and technology for emergency response from accidents. This capability can also be used by industry to enable an improved rapid analysis capability for cleanup at contaminated sites.

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KEYWORDS: Convergence, environmental sensor, contaminant detection, soil, water, microelectromechanical system (MEMS)

A13-080 TITLE: Efficient Water Vapor Harvesting Systems

TECHNOLOGY AREAS: Materials/Processes

ACQUISITION PROGRAM: PEO Combat Support & Combat Service Support

OBJECTIVE: Develop an efficient water vapor harvesting technology that can recover water vapor from centralized bathing facilities and similar infrastructure.

DESCRIPTION: Supply of water for potable uses at contingency operating bases (COBs) represents a significant logistical and economic burden for the Army. To help alleviate this burden, on-site water treatment with reverse osmosis (RO) membrane technology has been applied for tactical water production. For areas with limited source water availability, on-site water generation systems that extract water vapor from air have been developed. However, current water generation systems are energy-intensive, which limits their broader application. An example of a water vapor extraction system is the use of a solid desiccant like silica for adsorbing water vapor, followed by displacement of the adsorbed water by heating back to the vapor phase, and then condensation to produce clean water. Another approach uses ionic liquid desiccants. A more basic approach might entail the collection of condensate from cooling coils. In general, these approaches are more efficient in environments with higher relative humidity. Thus, the targeted application of these or other water vapor harvesting technologies in certain field infrastructure like centralized bathing facilities or other humid indoor environments is of potential interest. Existing ventilation systems for such facilities could be potentially modified to harvest water vapor at a reduced energy cost.

To support the Army's goal of reducing water demand at contingency operating bases (COBs) by 75%, in support of Army Science & Technology Challenge Area 4a, SBIR proposals are sought that will further onsite water generation capabilities at COBs. Specifically, the development of a supply side water generation technology that harvests water vapor from existing infrastructure is desired. Technologies that could integrate with existing field infrastructure systems such as shower stalls are of interest. Innovative systems that use alternative approaches to conventional desiccant technology but still produce the same quality of product water are also of interest. Systems should not require extensive post-treatment (beyond granular activated carbon polishing, microfiltration, and chlorination).

Systems should be designed and tested against the following metrics:
1) Energy consumption of less than 40 Wh/gal (Watt-hours per gallon) product water, after discounting the energy leveraged from existing infrastructure (i.e., ventilation fans), when harvesting water from air with an average relative humidity (RH) of 80% and air temperature of 28oC.
2) Ability to produce at least 20 gallons-per-day (gpd) of field potable water for the design case of a centralized bathing facility, described in more detail in the following sections.1
3) Maintenance requirement of less than 30 min/week.

PHASE I: Phase I should include a bench scale demonstration of the water vapor harvesting capability and a detailed engineering estimate of the expected energy efficiency, maintenance requirements, and physical footprint for a pilot scale design. Water harvesting performance testing shall be performed over a period of at least 1 month in a manner that generates reproducible and accurate data. For pilot scale design purposes, assume the following attributes for a generic centralized bathing facility: 1) centralized shower facility; 2) interior volume of 1400 cubic feet, air temperature of 28oC, and average RH of 80% when ventilation fans are operational; 3) 8 water-efficient showerheads running intermittently for 6 hrs/day each in a semi-diurnal cycle with a water temperature of 40oC; 4) Exhaust ventilation at 1000 cfm for 10 hr/day. Bench scale testing should be scaled down from the pilot scale accordingly. During bench scale testing, product water quality should be evaluated at least once per week for total dissolved solids TDS), total coliform (TC) bacterial contamination, and total organic carbon (TOC). Engineering estimates of energy efficiency, maintenance requirements, and physical footprint shall be made for a pilot scale system that can harvest at least 20 gpd.

The metrics for Phase I include:
1) Projected energy efficiency of < 40 Wh/gal at pilot scale, after discounting the projected energy leveraged from existing infrastructure (i.e., ventilation fans), when harvesting water from air with an average relative humidity of 80%.

2) Product water quality having TDS < 500 mg/L; TC < 1 cfu/100 ml; and TOC < 0.5 mg/L.

PHASE II: Phase II should include design, assembly, and assessment of a pilot scale system prototype in a simulated relevant environment. The first year should focus on design and assembly of the prototype and test chamber. Designs shall be drafted using professional grade drafting software, with all parts specified in terms of size, material, and source. Systems shall be assembled by the end of the first year of Phase II funding. The second year of Phase II should focus on testing the system at pilot scale in a simulated relevant environment. Systems should be tested over a 3-month period using a test protocol that clearly addresses the metrics described below.

For pilot scale design purposes, assume the following attributes for a generic centralized bathing facility: 1) centralized shower facility; 2) interior volume of 1400 cubic feet, air temperature of 28oC, and average RH of 80% when ventilation fans are operational; 3) 8 water-efficient showerheads running intermittently for 6 hrs/day each in a semi-diurnal cycle with a water temperature of 40oC; 4) Exhaust ventilation at 1000 cfm for 10 hr/day. During pilot scale testing, product water quality, energy consumption, and maintenance requirements shall be documented in detail. Product water quality measurements will be taken on a weekly basis and include: TDS, TC, TOC, and any potential materials that might leach into the product water from the vapor harvesting system itself, such as metals, specific organics, ions, etc.

Phase II products shall include:
1) A pilot scale water vapor harvesting system that is ready for transition to integration with existing infrastructure.
2) A report detailing water vapor harvesting efficiency, energy consumption, product water quality, and maintenance requirements over a 3-month test period.

Phase II metrics include:
1) Demonstration of maintenance intervals of at least one week and less than 30 minutes in duration (each).
2) Production of at least 20 gpd of field potable water per day, having TDS < 500 mg/L; TC < 1 cfu/100 ml; and TOC < 0.5 mg/L, and data supporting that it will meet field potability standards.1
3) Demonstration of energy efficiency of <40 Wh/gal, after discounting the energy leveraged from existing infrastructure (i.e., ventilation fans), when harvesting water from air with an average relative humidity of 80%.

PHASE III: Military applications for a system that meets the metrics described herein may include water generation in contingency operating environments and at installations, and natural disaster response systems. Additional commercial markets may include: water vapor harvesting systems for residential, commercial, or industrial applications.

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KEYWORDS: Water vapor harvesting, water generation, water from air, condensation, desiccant, water supply, drinking water production.

A13-081 TITLE: Measuring whole body fluorescence and movement in freely swimming transgenic zebrafish for measuring stress from exposure to environmental stressors

TECHNOLOGY AREAS: Materials/Processes

OBJECTIVE: The objective of this project is to develop a turnkey system of software and hardware necessary to measure whole-body fluorescence in freely swimming zebrafish under stress from environmental contaminants or stressors such as Hg, Pb, or temperature.

DESCRIPTION: Military operations at installations or when deployed produce environmental contaminants. Some are the result of military test and training activities (e.g., heavy metals) and others result from routine base activities (e.g., chemical spills). Assessing the impacts of environmental contamination is difficult especially at very low concentrations over long time periods. Relating exposure to changes in behavior and the connections to animal

fitness and populations is even more difficult to establish. Facility managers would benefit from tools that relate exposure to changes in stress and behavior in animals under low concentrations of environmental contaminants.

The offeror will develop a turnkey system of hardware (cameras, lighting, test domains) and software to quantify the whole-body fluorescence and movement (x,y,z, time) in freely swimming transgenic zebrafish under laboratory conditions. The fluorescent markers that are used mark genes that transcribe specific proteins. The genes and the proteins that are marked are generally conserved across all fish and perhaps most vertebrates, including humans. In fact, zebrafish cellular and genetic functions are often a model for studying human physiology. Mapping zebrafish protein transcription to other species and to humans is commonly done as the molecular mechanisms are conserved at the cellular level.

The system will consist of a test domain (tank) monitored by multiple video cameras. Appropriate illumination suitable to record behavior and excite the fluorescent protein of interest is required. The cameras will record the spatial position (e.g. via video) and the fluorescence intensity (measured as pixel intensity) of a freely swimming fish at a high frequency (minimum of 1 measurement/sec). Pixel intensity will be extracted from image files of the fish and may be standardized between 0 and 1. Distance between the video camera and the test domain will depend on camera resolution and domain size at a minimum. For a given test the cameras, once positioned, will not be moved. The test domain can be of various sizes with a minimum size being a typical 10 gallon aquarium with limited turbidity. Larger sizes are also of interest depending on experimental needs and may require multiple cameras. The system must be able to track one fish or multiple fish (e.g. >200 fish simultaneously). The system will then be able to post-process the measured fish track and pixel intensity values to produce metrics of behavior (e.g. swim speed and angle), provide animations of the track, and to colorize pixel intensity estimates according to which protein (e.g., mCherry or GFP) is being illuminated. A function graphical user interface that facilitates camera calibration, accuracy estimation, and experiment implementation should be included.

PHASE I: The offeror will design architecture and integration methodology for the integrated hardware and software. The design should incorporate the ability to record spatial position with the ability to post-process the measured values and provide visual output, all within a function graphical user interface. The approach to design used should pay particular attention to how measurement noise will be managed with emphasis on system lighting design. The desired Phase I product is a report that describes the design architecture and integration methodology needed to develop a hardware and software system that meets the requirements laid out in the topic description.

PHASE II: Phase II – Year 1 shall produce a working hardware and software system alpha version that will highlight the expected hardware performance tradeoffs, data storage, and operation via the graphic user interface. Phase II – Year 2 shall produce a beta version of the system, fully capable of measuring movement and fluorescence in a single freely swimming fish. The working system shall record all relevant data and produce output files that can be used for further analysis. The beta version software platform should have an intuitive user interface with flexible application to a range of problems (e.g., different fluorescent proteins, different stressors, different lighting requirements) and different sized test domains (e.g. 10 gallon up to a larger as yet to be determined size). Particular attention should be applied to making sure that measurements are repeatable and have a manageable level of noise. The offerer will provide a report that documents the design utilized for a turnkey system to measure whole-body fluorescence in freely swimming zebrafish under stress from environmental contaminants or stressors such as Hg, Pb or temperature, and the results of a functionality demonstration.

PHASE III DUAL USE APPLICATIONS: This program could be expanded to include a wider range of fluorescent proteins and settings and to handle motile fish simultaneously. This type of program may have great value from a toxicology and behavior study perspective, and potentially as a method to monitor the integrity of municipal and agricultural water supplies. A full experimental demonstration of the ability to measure movement and whole body fluorescence should be part of this phase. This technology has potential commercial applications in the areas of water and waste management.

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KEYWORDS: Fluorescence, stress, behavior, zebrafish, Military contaminants, Contaminant management

A13-082 TITLE: Rapid, Point of Care Therapeutic Drug Monitoring Device

TECHNOLOGY AREAS: Biomedical

ACQUISITION PROGRAM: Office of the Principal Assistant for Acquisition

OBJECTIVE: Develop a miniaturized, point of care, analyzer for rapidly determining peak and trough concentrations of antibiotics and antifungals in blood and serum to provide for real-time therapeutic drug monitoring in fixed and field medical treatment facilities.

DESCRIPTION: Antibiotics are one of the most commonly prescribed and therapeutically monitored drugs in clinical practice. Due to issues related to efficacy and toxicity, select groups of antibiotics (e.g. aminoglycosides, glycopeptides) and antifungals (e.g azoles) are typically monitored for peak and trough concentrations in serum. Aminoglycosides, such as gentamicin, tobramycin and amikacin, are frequently used to treat potentially life threatening gram negative infection in wounded soldiers. Vancomycin, a glycopeptide, is the most frequently prescribed drug to treat methicillin resistant Staphylococcus aureus infections. Currently, these drugs are therapeutically monitored by commercially available platforms and tests. While commercial systems can determine peak and trough concentrations of many antibiotics and antifungals, they are generally large, require an inventory of several different individual assays, and have turn-around-times (TAT) that not conducive to real-time monitoring. These shortcomings make these systems less than ideal for the monitoring of drugs at deployed medical treatment facilities, which require smaller devices, smaller inventories of tests and more rapid TAT. A small, rapid, drug generic (e.g. STAT test) point-of-care like device is needed that can determine peak and trough concentrations of antibiotics and other therapeutic drugs in real-time so that medical practitioners can make more accurate decision on dosing and toxicity of administered drugs.

PHASE I: During this Phase I, the contractor will develop and demonstrate a prototype, point-of-care analyzer for rapidly determining concentrations of antibiotics in liquids to provide for real-time therapeutic drug monitoring of a variety of drugs. The analyzer envisioned should have the following characteristics. The analyzer should have minimal processing steps, or preferably be autoprocessing capable. It should be capable of providing a resultant drug concentration in less than 60 minutes of sample receipt, including all sample preparation time. The analyzer should be a single device capable of identifying a wide range of drugs at both low (e.g. <0.1 µg/ml) and high concentrations (>100 µg/ml). It should have a user friendly interface and be capable of resulting out drug identification and concentration in a format that is easy to read and understand. The analyzer should be no larger than 24 cubic inches in dimension and preferably be smaller than 12 cubic inches. The specific deliverables of this Phase I award will be 1) the contractor will develop a prototype analyzer matching the above description and 2) will determine the feasibility of the analyzer for identifying and defining the detectable concentration ranges for vancomycin and tobramycin in a simple sample matrix, such as phosphate buffered saline. Technical Readiness Level (TRL) level at the end of Phase I should be TRL4.

PHASE II: The contractor will further develop and optimize the prototype, point-of-care analyzer for determining concentrations of a variety of antibiotics and antifungals in complex matrices. The contractor will demonstrate the ability of analyzer to identify the following antibiotics and antifungals in blood and serum: vancomycin, teicoplanin, telavancin tobramycin, gentamicin, amikacin, arbekacin, colistin, amphotericin B, itraconazole,

fluconazole, voriconazole, posaconazole, and flucytosine; and will define the detectable concentration ranges for each drug in these matrices. Contractor is highly encouraged to demonstrate analyzer's ability to identify and define concentration ranges of other antibiotics and antifungals and other drugs. During PHASE II, the contractor is expected to develop and implement the all the preclinical work needed to advance the prototype analyzer into clinical development. At the end of PHASE II, it is envisioned that the contractor will have conducted a pre-investigation device exemption (IDE) communication with the Food and Drug Administration (FDA), completed all the necessary preclinical studies, and obtained approvals for protocols required for moving the analyzer into clinical studies enroute to FDA clearance. TRL level at the end of Phase II should be TRL5.

PHASE III: During PHASE III, the contractor will design, develop and execute required clinical studies to support a 510(k) submission to the FDA to obtain clearance for the analyzer. The envisioned endstate for PHASE III is an analyzer that is FDA cleared to determine and monitor peak and trough concentrations for vancomycin, tobramycin, gentamicin, amikacin, colistin, itraconazole, voriconazole, posaconazole, and flucytosine. Contractor is highly encouraged to obtain FDA clearance for determining the peak and trough concentrations of other antibiotics, antifungals and drugs. TRL level at the end of Phase III should be TRL8.

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KEYWORDS: antibiotic, antifungal, drug, monitoring, prototype, analyzer, point-of-care, real-time, concentration

A13-083 TITLE: A Software Tool to Assess Impact of Load Carriage and Body-Wearable Robotic Devices on Musculo-Skeletal Health and Performance

TECHNOLOGY AREAS: Biomedical

OBJECTIVE: Develop a software simulation tool that accurately models the external force/torque inputs and risk of injury to the musculoskeletal system of soldiers carrying loads with and without assistance from body-wearable robotic devices.

DESCRIPTION: Soldiers, Marines, Sailors, and Airmen on foot and engaged in field training or combat operations often carry heavy loads (35-65 kg or more) consisting of basic clothing and individual equipment and added mission-specific gear (1, 2). Missions are often in harsh environments and can last from hours to weeks. Limited opportunities for resupply drive soldiers to carry everything needed for the mission. Carrying heavy loads increases metabolic energy expenditures, degrades gross- and fine-motor physical performance, and results in significant pain and discomfort, as well as musculoskeletal injury (2, 3).

Notably, musculoskeletal injury rates have increased six-fold since the 1980s, with the rate of injury in women outpacing that of men. The majority of musculoskeletal injuries are associated with overuse (3), with excessive load carriage recognized as a contributing factor (1, 2). In an attempt to mitigate the effects of excessive loads, the Military is actively investigating the use of performance-augmenting robotic devices by its troops. However, comprehensive scientific understanding of the overall impact of load carriage and of the use of such assistive devices on physical performance and risk of musculoskeletal injury is just emerging (4, 5).

PHASE I Provide a detailed plan and a proposed software architecture needed to develop a simulation tool that would enable the effects of both unassisted and robotically-assisted load carriage on joint and muscle loading to be examined. This will require extending the state of the art in modeling and simulation of human gait, and both human and machine joint kinematics in order to apply both the forces applied by the loads typically carried by the military and by existing and future wearable robotic structures to the human anatomy.

a) Determine if there is sufficient information available in the open scientific literature to be able to accurately describe the load-carriage related physical constraints of, and force and torque inputs to, the human musculoskeletal system with particular emphasis on the muscle groups and joints most likely to be affected during lower extremity assistive device use.

b) Provide a detailed plan for developing a simulation tool using, for example, a musculoskeletal simulator such as OPENSIM or SIMM (8), that accurately models the physical constraints and force/torque inputs to the human musculoskeletal system associated with normal load carriage activities performed while using one or more existing body-worn robotic assistive devices. This simulation tool should enable the user to quantify the overall effect on the wearer of the use of assistive devices on agility, metabolic costs, load carriage performance, and ultimately, risk of musculoskeletal injury.

c) Develop the study plans required to develop and validate the simulation. No testing with human test volunteers will be needed in Phase I.

PHASE II: Create a simulation tool that would enable the effect of load carriage on joint and muscle loading to be examined with and without one or more of the body-wearable devices identified in Phase I. The simulation should be of sufficient anatomic detail to enable the extraction of individual muscle forces and excitation patterns from simulation output. It should be sufficiently extensible as to allow for the eventual kinematic modeling of particular individuals. It should enable the evaluation of the overall effect of assistive device use on agility, metabolic cost, and load carriage performance, and risk of musculoskeletal injury in terms of peak and Root-Mean-Square (RMS) force and power output of individual muscles and muscle groups.

a) Define constraints that would be imposed by the assistive device(s) on human motion, accurately reflecting the mechanical and kinematic compliance of the body-wearable device(s) relative to the wearer. Utilize the simulation tool to create a model of one or more canonical task(s) of interest, such as lifting, running, and throwing.

b) Develop scripting methods for performing Monte Carlo simulations of both nominal and off-nominal use cases, and conduct simulations of the body-wearable device(s) for identified canonical tasks for a range of muscle activation rates (e.g. slow vs. explosive motions). Simulation parameter boundary conditions would be drawn from literature, or from Government-provided human subject data (if available).

c) Deliver a prototype simulation tool suitable for test, validation, and use by Government subject matter experts to examine the effect of normal load carriage activities on joint and muscle loading and risk of acute and chronic injury with or without assistive devices. Testing with human test volunteers may be needed in Phase II to validate the simulation.

PHASE III: The envisioned end state of this research and development effort is a commercial-grade simulation and analysis product suitable for use in industrial situations where new jobs are being established and/or the use of new equipment, including personal robotic assistive devices, is being considered. This product would also be of great use as the body-worn robotic assistive devices transition from Military and Industrial settings into Medical and Rehabilitative settings. The ability to simulate the impact of new jobs and new equipment on musculoskeletal performance and the potential for injury would benefit the Government oversight groups such as National Institute for Occupational Safety and Health (NIOSH) and industry by ensuring safe and efficient work environments.

Furthermore, the ability to perform initial evaluations of proposed robotic assistive devices in a timely manner without the need for costly and time consuming experimentation with human test volunteers would be beneficial.

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KEYWORDS: muscle injury; exoskeleton; biomedical modeling; performance augmentation; rehabilitation; kinematics; kinematic simulation

A13-084 TITLE: Technologies That Regenerate Peripheral Nerve Defects

TECHNOLOGY AREAS: Biomedical

ACQUISITION PROGRAM: Office of the Principal Assistant for Acquisition

OBJECTIVE: The objective of this effort is to develop a new innovative technology that may include the use of novel materials, nanotopology, cellular/tissue-based strategies or biologics, to accelerate peripheral nerve regeneration and functional recovery in defects greater than 3 cm.

DESCRIPTION: Segmental nerve defects have limited potential for spontaneous recovery and are often associated with devastating functional deficiencies. It is known that 5-6% of all military injuries involve major injury to a peripheral nerve. Before World War II (WW II) nerve injuries were repaired as simple reapproximation and suturing procedures often conducted under tension. They were often further complicated by surrounding tissue damage and infection. Poor outcomes from these procedures were discovered to be the result of failed axonal regeneration at the site of repair. Here we recognize the need for medical interventions to address large gap (> 3 cm) peripheral nerve injuries. While tension-free autografting remains the gold standard in the field it may not be appropriate in cases where extensive injury prohibits the use of autologus tissue (i.e. sural nerve harvest) from the wounded warrior. Early research in the field also demonstrated success with tissue based ensheathment approaches. In recent times

conduits and scaffolds of allogenic or synthetic matrices that provide guidance for axonal regeneration now show much promise. As the therapeutic field continues to advance, it is likely nanotopology, cellular, mechanical, biologic or pharmacological components may also be incorporated to facilitate the repair of larger peripheral nerve defects (gaps > 3cm). Technologies proposed under this topic should address the current limitations of available technologies or propose new technologies intended to promote the efficient and reproducible repair of peripheral nerve defects as defined by functional improvement and provide an alternative to autograft harvest

PHASE I: Conceptualize and design an innovative solution which will promote the repair and regeneration of large gap peripheral nerve defects (> 3 cm) ultimately targeting functional improvement of the affected tissues. Such technologies may include biomaterials, nanotopology, cellular, tissue or biological components meant to facilitate controlled axonal outgrowth or promote ensheathment. It is likely that the most successful constructs may incorporate two or more of the described components. The required Phase I deliverables will include: 1) a research design for the proposed technology that is intended to provide some preliminary in vitro supporting evidence for addressing nerve defects (to be executed at Phase I), and 2) A preliminary prototype or composition of matter description with supporting rationale. Other supportive data from in vivo proof-of-concept studies demonstrating tissue or organ reinnervation which lead to functional improvement may also be provided during this 6-month Phase I, $100K (max) effort.

PHASE II: The researcher shall design, develop, test, finalize and validate the practical implementation of the prototype technology that implements the Phase I methodology to promote peripheral nerve defect repair over this 2-year, $1.0M (max) effort. The researcher shall also describe in detail the transition plan for the Phase III effort.

PHASE III: Plans on the commercialization/technology transition and regulatory pathway should be executed here and lead to FDA clearance/approval. They include: 1) identifying a relevant patient population for clinical testing to evaluate safety and efficacy and 2) GMP manufacturing sufficient materials for evaluation. The small business should also provide a strategy to secure additional funding from non-SBIR government sources and /or the private sector to support these efforts.
Military application: The desired therapy will allow military practitioners to apply the therapy.
Commercial application: Healthcare professionals world-wide could utilize this product as a therapy meant to improve the standard of care presently available to patients suffering from large gap peripheral nerve defects.

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KEYWORDS: large gap peripheral nerve defects, scaffold, biomaterial, axonal outgrowth, ensheathment, neural regeneration

A13-085 TITLE: Enhanced Biocompatible Materials for the Repair of Ocular Injuries

TECHNOLOGY AREAS: Biomedical

ACQUISITION PROGRAM: Office of the Principal Assistant for Acquisition

OBJECTIVE: The objective of this effort is to develop and/or improve biocompatible materials for the repair/treatment of traumatic war-related injuries to the exposed ocular surface.

DESCRIPTION: This SBIR topic seeks to develop and/or improve concepts for biocompatible materials for the restoration of vision following ocular trauma in military personnel. War-related ocular trauma has risen during the current conflicts due to technological advances including the use of improvised explosive devices (1). It is estimated that the rate of eye injuries relative to the overall injury rate in military personnel having served in Iraq and Afghanistan is approximately 13-16% (2). Thus, the military has placed an increased emphasis on restoring and rehabilitating injured Warfighters with functional capabilities that provide the ability to return the Warfighter to their duty performance, not just improve a patient's ability to function in daily life with impairment.

To meet this goal, effective biocompatible materials that enhance treatment and improve visual outcomes following ocular surface injury are needed. Currently, human amniotic membrane can be used as an ocular dressing to mitigate the deleterious effects (i.e. inflammation, pain, scarring) patients experience following ocular injury (3, 4). Human amniotic membrane use as an ocular dressing however is limited due to cost and material preparation procedures that may attenuate human amniotic membrane's healing properties. Envisioned are biomaterials (5) that allow for immediate stabilization of the eye following trauma, while also promoting ocular tissue repair, healing, and prevention of infection. The proposed treatment strategy should improve visual outcomes for patients having experienced ocular trauma. Highly novel approaches that decrease the need for suturing and/or the use of cyanoacrylate and fibrin-based tissue adhesives (6, 7) following ocular trauma may also be considered (8, 9).

PHASE I: Define a conceptual approach for a technology that meets the intent of the SBIR topic for enhanced biocompatible materials for the repair/treatment of ocular surface injuries. Phase I deliverables will include: a technical report that outlines the research design of the proposed biomaterial, preliminary proof-of-concept data demonstrating the feasibility of the approach and a detailed analysis that defines the predicted performance of the end product.

PHASE II: Develop, test, finalize, and validate the prototype system(s) defined by the Phase 1 design. Quantifiable performance measures for the technology should be determined that are sufficient to assess the ability to provide an effective treatment. Also, the researcher shall conduct preclinical studies in support of testing the technology in humans. Phase II deliverables include: testing and validation of the prototype system, technical reports documenting the appropriate performance measures for the technology, conduct of preclinical studies to support testing the technology in humans, and a roadmap report that addresses in detail the transition plan for the Phase III effort.

PHASE III DUAL USE APPLICATIONS: Technology innovations developed through this SBIR would also have dual use application for vision restoration in the military and civilian sectors. The technologies would provide for significantly improved capabilities that could also reduce the impact (cost, workload, etc) of providing associated clinical services both in military and non-military settings.

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KEYWORDS: Vision, restoration, biocompatible, trauma, treatment, ocular

A13-086 TITLE: User-worn Rehabilitative Devices for Balance Disorders

TECHNOLOGY AREAS: Biomedical

ACQUISITION PROGRAM: Office of the Principal Assistant for Acquisition

OBJECTIVE: The objective of this effort is to develop user-worn medical devices to support the rehabilitation of balance disorders, including sensory augmentation/substitution technologies.

DESCRIPTION: This SBIR topic seeks to develop innovative concepts for the rehabilitation of balance disorders in military personnel using user-worn devices. Trauma and blast injuries, including traumatic brain injury (TBI), during military service can lead to vestibular dysfunction, including balance disorders (1-3). The military has placed an increased emphasis on restoring and rehabilitating injured Warfighters with functional capabilities that provide the ability to return the Warfighter to their duty performance, not just improve a patient's ability to function in daily life with impairment. Unfortunately, rehabilitative treatments can require long, intensive processes to recover function.

Effective short duration, balance rehabilitation strategies and supporting technologies are needed. Envisioned is a short-term treatment course that, once completed, ideally resolves the balance disorder permanently or that might only need to be repeated at very infrequent intervals should the treatment effect wear off. User-worn devices are intended to remove rehabilitation efforts from specialized settings and training/exercise regimens and allow "continuous" rehabilitative treatment while the patient is at home and during routine daily activities. The proposed treatment strategy should ideally return the patient to duty performance levels. Additionally, novel concepts for user-worn assistive devices which provide sensory substitution or augmentation for balance disorders that cannot be rehabilitated may be considered as well.

PHASE I: Define a conceptual approach for a technology and employing the technology that meets the intent of the SBIR topic for user-worn balance rehabilitation devices. Phase I deliverable: technical report that outlines the technology approach, establishes the feasibility of the approach using existing data and investigations conducted during Phase I, and a detailed analysis that defines the predicted performance of the end product.

PHASE II: Assemble, test and deliver the prototype system(s) defined by the Phase 1 design. Quantifiable performance measures for the technology should be determined that are sufficient to assess the ability to provide an effective treatment. Also, the researcher shall conduct studies in support of testing the technology in humans. Phase II deliverables include: testing and delivery of the prototype system, technical reports documenting the appropriate performance measures for the technology, conduct of studies to support testing the technology in humans, and a roadmap report that addresses in detail the transition plan for the Phase III effort.

PHASE III DUAL USE APPLICATIONS: Technology innovations developed through this SBIR would also have dual use application for balance rehabilitation in the Department of Veterans Affairs and civilian sectors. The technologies would provide for significantly improved capabilities that could also reduce the impact (cost, workload, etc) of providing associated clinical services both in military and non-military settings.

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KEYWORDS: Balance, vestibular, rehabilitation, treatment, mobile, sensory

A13-087 TITLE: Handheld Adipose Stem Cell Processor for Point of Care Application

TECHNOLOGY AREAS: Biomedical

ACQUISITION PROGRAM: Office of the Principal Assistant for Acquisition

OBJECTIVE: Develop a low cost, handheld tool that fully integrates the process from fat tissue harvest to high quality stem cell product, enabling point of care application of adipose derived stem cell therapy.

DESCRIPTION: Adipose derived stem cells, in particular the stromal vascular fraction (SVF), are attractive for regenerative medicine applications because of the ease of accessibility, multipotency of the cells, and avoidance of ethical issues. The current process for extracting, isolating, and processing of adipose derived stem cells has limitations including processing time and size of the instrument. These limitations also impact the workflow of the surgeon in providing novel cell therapy for point of care applications. Therefore, development of a handheld tool that could streamline and integrate the collection and the subsequent processing of adipose lipoaspirate tissue to result in a sterile, concentrated stem cell product ready for use will enable applications of cell therapy at point of care. This SBIR topic seeks for a novel, integrated tissue and cell recovery system for rapid processing and recovery of desired regenerative cells with cell recovery from 5-20 million, with greater than 75% cell viability, and be free of fibrous material and cell debris. The solution also needs to address current technology limitations such as sterility breaks, acquisition and process time, complexity of operation, and cost. Development of this technology should provide for convenient and rapid extraction of millions of processed regenerative stem cells as a readily available source of adult stem cells for therapeutic applications to treat diseases and traumas such as Parkinson's and wound repair respectively. Solution should take into consideration of the surgeon's workflow and provide for an ergonomic design. The process design should not harm cells and provide for the highest number of stem cells recovered, resulting in a population of quality stem cells readily available for use.

PHASE I: Conceptualize and design an innovative solution that meets the topic's objective. Required Phase I deliverables will include concept design, schematic drawings, anticipated performance metrics for the device, specifications, plans for testing and evaluation for Phase II implementation, and a well-developed business model or plan for commercialization (this should include estimated manufacturing cost). No animal or human use testing is to be proposed or executed during this 6-month Phase I period. Cells should be from commercial sources (if from other methods of procurement requiring institutional regulatory approval, this must already be approved prior to proposal submission).

PHASE II: Finalize design, development, and demonstration of proposed solution based on results from Phase I. This includes building a preliminary prototype for testing and evaluating the technical feasibility. The demonstration of proof-of-concept should confirm and/or establish performance metrics (e.g. cell processing time). Additional required Phase II deliverables will include design improvements to the prototype, demonstration in an operational setting, validation of cell extraction using standard assays and/or methods, determination of performance metrics including processing time and sterility confirmation, and a refined technology transition and/or commercialization plan including manufacturing and regulatory pathway (also provide an updated manufacturing cost). Statistical power should be adequate to document performance metrics.

PHASE III: Phase III efforts should lead to 510K clearance or other appropriate regulatory approval and be focused towards technology transition, preferably commercialization of SBIR research and development. Efforts leading to 510K clearance or regulatory approval require execution of Phase II plans on commercialization and regulatory pathway. The small business should have in plans to secure funding from non-SBIR government sources and /or the

private sector to develop or transition the prototype into a viable product for sale in the military and/or private sector markets. Commercialization plans that include the private sector markets generally help lower cost through economy of scale.

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KEYWORDS: adipose stem cell, cell processing, cell harvesting, regenerative medicine, cell therapy

A13-088 TITLE: Innovative Lightweight Energy and Water Efficient Treatment System for Fluid Medical Waste

TECHNOLOGY AREAS: Biomedical

OBJECTIVE: The successful applicant will develop an innovative method or system which will render liquid and other fluid medical (biohazard) waste products sterile and otherwise inert to the environment in austere, deployed locations. Currently autoclaving and/or chemical treatment (1:10 bleach solution) or open pit burning methods are used to support our Combat Support Hospitals (CSH), Forward Surgical Teams (FST), dental units, and other deployed medical units and treatment facilities.

Management of biological/medical waste in the deployed environment was identified as a key area of need for investigation and improvement by the participants at the TATRC (Telemedicine and Advanced Technology Research Center) sponsored Medical Logistics Integrated Research Team (IRT) conference conducted in May of 2005.

DESCRIPTION: We are seeking an innovative method or system which will render liquid and other fluid medical (biohazard) waste products sterile and otherwise inert to the environment in austere, deployed locations. Currently autoclaving and/or chemical treatment (1:10 bleach solution) or open pit burning methods are used to support Combat Support Hospitals (CSH), Forward Surgical Teams (FST), dental units, and other deployed medical units and treatment facilities. Although these methods do mitigate the risk of pathogenic and/or chemical contamination of the environment they only reduce the levels of agents left behind; they cannot assure total inactivation of all pathogens or the neutralization of chemical agents. In fact chemical treatment (bleach) and open pit burning leave behind additional undesirable residues, and open pit burning is likely to produce risk to those personnel engaged in the activity as well as air quality.

In addition to traditional contaminants found in waste water, new threats are being recognized. The Environmental Protection Agency (EPA) has recognized such threats: “Chemicals are being discovered in water that previously had not been detected or are being detected at levels that may be significantly different than expected. These are often generally referred to as “contaminants of emerging concern” (CECs) because the risk to human health and the environment associated with their presence, frequency of occurrence, or source may not be known. EPA is working to improve its understanding of a number of CECs, particularly pharmaceuticals and personal care products (PPCPs) and perfluorinated compounds among others”. Although the disposal of unused pharmaceutical and other materials

in the waste stream can be and is regulated there is no acceptable way, known at present, to regulate or treat those agents that get into the waste stream as part of human or animal excretion as unmetabolized drugs.

Minimal success of this effort will produce an effluent stream that meets or exceeds the requirements of Section 304(a)(1) of the Clean Water Act, criteria for water quality, and Water Quality Standards: CFR Title 40 Part 131. The desired outcome will render the effluent harmless to the environment by killing or neutralizing all pathogenic organisms and other microbiological agents and by denaturing and making inert chemical contaminants to include pharmaceutical residues. Ideally this effluent will be of sufficient quality that it may be used as feed stock for reuse with minimal additional treatment.

PHASE I: Phase I will develop a methodology (technology) and design concept for a system that will render fluid medical/biological waste harmless to the environment as described above. Since no such system exists today the solution will be both innovative and novel. The desired system will be compact and will require a minimum of energy to operate. The ideal goal will be to develop a basic unit that approximates the size of a household dishwasher or clothes washer with a weight of approximately 300 pounds which requires five amps or less of power while treating about 200 gallons of fluid waste per hour. This technology should be scalable so that smaller units capable of treating lesser amounts of waste as well as larger units which will treat very large volumes of waste while consuming appropriate levels of power can be fabricated. Scalability of the process may be deemed a significant factor in the overall success of the effort. The system should be easy to move, set-up, operate and maintain by soldiers in an austere environment. Water and energy demands of this system should be minimal. Implicit in the design concept is a testing plan and metrics to assure that the system is capable of destruction of pathogens and other organisms and the denaturing or destruction of pharmaceutical and other potentially harmful compounds in the waste stream, thus rendering any effluent safe to the environment. An ideal solution will provide a system design which is scalable and which provides a continuous flow process and which will ideally be applicable to gray and/or black water waste stream treatment. This capability will enable the fabrication of units capable of supporting generators of small volumes of waste as well as those that generate large volumes on a nearly continuous basis. This Phase I effort will span six months and will encompass no more than $100K of effort.

PHASE II: Phase II will establish performance parameters through experiments and prototype fabrication. This prototype will, as close as possible, meet the requirements stated above for the Phase I design concept. The Phase II effort will continue to refine the objective to develop a basic unit that approximates the size of a household dishwasher or clothes washer weighing 300 pounds or less which will requires not more than five amps of power while treating about 200 gallons of fluid per hour. The scalability of the technology should be further evolved so that smaller and larger units can be fabricated which will treat lesser and greater volumes of waste while requiring appropriately scaled power levels. The expectation is that at the conclusion of Phase II the prototype will be ready for commercialization and production in a potential Third Phase. This effort will encompass no more than two years and $1.0M of effort.

PHASE III DUAL USE APPLICATIONS: Significant dual use applications exist for this technology. Dual use applications include utilization within both the civil and military environments. The immediate goal of this solicitation is to serve deployable military medical, dental, veterinary, mortuary and similar facilities. Also, within the military, such a system could be used in a number of areas beyond those enumerated above, including use aboard Navy ships where medical/biological wastes could be treated before discharge overboard. In remote or small medical facilities such a system might be used as the primary means of destruction of bio waste. The ideal solution would also be capable of treating sanitary waste streams, to include both gray and black water where such a scalable system could be used at remote locations, at individual facilities or for small communities. Civilian uses of the technology would parallel those of the military. The system will be of value in small or remote medical facilities, in small clinics or practices and, if scaled up, at hospitals or larger facilities. Smaller appliances might be used in hospital and other facilities to pre-treat certain medical/biological wastes, such as operating room waste fluids, before they are discharged into municipal sanitary sewage systems. A large “portable” version of such a system might be constructed that could be used in disaster situations to temporarily replace or supplement waste treatment systems damaged or destroyed by the event. In addition to the military medical enterprise other DoD users/customers may include Force Sustainment and Force Provider activities. Any activity that provides troop support, environmental or hazmat management support is also a potential user.

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KEYWORDS: waste treatment, medical waste, biological waste, biohazard, pharmaceutical residues

A13-089 TITLE: Remote Triage of Combat Casualties

TECHNOLOGY AREAS: Biomedical

ACQUISITION PROGRAM: Office of the Principal Assistant for Acquisition

OBJECTIVE: Develop a stand-alone device for the remote triage of wounded soldiers on the battlefield to rapidly assess vital signs from a distance.

DESCRIPTION: When a soldier is injured on the battlefield, medical personnel, as well as non-medical first responders, must physically reach the soldier to determine whether or not the soldier needs immediate medical attention (triage). Triage sorts casualties based on the severity of their injuries with the aim to treat, monitor, and evacuate casualties to the appropriate level of care. In an effort to reduce the need to put first responders in harm’s way, a device is needed in order to accurately assess the vital signs of injured soldiers from a distance.

Per the Theater Combat Casualty Care (TC3) Initial Capabilities Document (ICD), a level one (1) priority is the ability to locate and evaluate casualties. First response capability requires improved material solutions to recognize, locate, assess, treat, monitor, and evacuate casualties without degradation to their condition. A remote triage solution provides rapid identification of casualties and enhances the skill level of all without placing them in further danger. This device would also provide medical personnel, as well as non-medical first responders, the ability to operate safely in a chemical, biological, radiological, nuclear (CBRN) environment.

Remote triage, integrated with telemedicine capabilities and the Theater Medical Information Program (TMIP) will allow increased capabilities for first responders by providing access to clinicians at higher levels of health care.

PHASE I: Conceptualize and design an innovative materiel solution for a remote triage device.

1) Develop an initial concept design and model key elements of the remote triage device for all the following requirements:
a. Detect and assess heart rate, blood pressure, and oxygen (O2) saturation with an minimum accuracy of 95%.
b. Assess vital signs through obstacles and debris made of materials such as wood, plaster, rock, metal, and concrete.
c. Assess vital signs at a minimum distance of 15 meters (Threshold [T]) with an unobstructed view; 50 meters (Objective [O]).
d. Must be stand-alone with no remote sensors required.
e. Must weigh no more than 10 pounds (T); 5 pounds (O).
f. Must be no larger than 2 cubic feet (ft3); 1 ft3 (O).
g. Continuously operate on standard disposable batteries for 6 hours (T); 12 hours (O).

2) Identify regulatory requirements and develop a plan detailing how they will be achieved.

The required Phase I deliverables are a technical feasibility report, the initial concept design, models of the key elements, and the regulatory requirements report and action plan.

PHASE II: Use the results from Phase I to develop, test, and demonstrate working prototypes based on the initial concept design adhering to any regulatory action plan developed.

In addition, monitor market research, literature updates, and military doctrine to conceptualize additional features and enhancements, such as the following:
- Measuring body temperature
- Circulating blood volume status
- Algorithms to assess status and determine severity
- Open architecture and integration into telemedicine and information networks
- Security, privacy, and confidentiality of patient data on the device and during transmission.

The required Phase II deliverables are the following:
1) Monthly progress report(s)
2) Annual report(s)
3) At least three working prototypes
4) Feasibility report regarding the additional Phase II considerations
5) Provide a detailed plan for life-cycle analysis and validation of the proposed design
6) Commercialization transition plan.

PHASE III: Focus on commercialization and continued development into a production ready device that meets all regulatory and user requirements. Explore tailoring to user needs (fit and form), additional vital signs, open architecture and system integration. Address and assess additional requirements, such as MIL-STD-810 testing.

This device has potential commercial applications in first responder, emergency assistance, or mass casualty scenarios in which finding wounded or trapped persons is essential and must be rapid. Organizations such as the Red Cross and the Federal Emergency Management Agency (FEMA), as well as emergency medical technicians and firefighters could utilize this technology for search and rescue of wounded in rubble, rescue victim location, and disaster recovery.

Additional use could be realized for medical monitoring in fixed facilities at all levels of military and civilian care.

Tactical scenarios, such as through-wall identification of targets and remote surveillance, are practical using this technology, benefitting special operations, federal investigators, and police SWAT teams.

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2. Manemeit, Carl and G.R. Gilbert, "Joint Medical Distance Support and Evacuation JCTD, Joint Combat Casualty Care System Concept of Employment," NATO HFM-182-33 paper, 21 April 2010.
http://ftp.rta.nato.int/public/PubFullText/RTO/MP/RTO-MP-HFM-182/MP-HFM-182-33.doc

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http://www.ists.dartmouth.edu/library/83.pdf

4. Initial Capabilities Document for Theater Combat Casualty Care (TC3), October 2007.

5. Ryan KL, Rickards CA, Hinojosa-Laborde C, Gerhardt RT, Cain J, Convertino VA. "Advanced technology development for remote triage applications in bleeding combat casualties." US Army Med Dep J. 2011 Apr-Jun: 61-72.

KEYWORDS: triage, combat casualty care, telemedicine, emergency medicine, vital signs, remote detection, first responder

A13-090 TITLE: Advanced Automated Assessment of Cognitive Changes Associated with Brain injury and Neurological Disease

TECHNOLOGY AREAS: Biomedical

ACQUISITION PROGRAM: Office of the Principal Assistant for Acquisition

OBJECTIVE: Develop a computerized cognitive assessment system that is primarily self-administering using video or avatar-based instructions and language recognition to assess language-based skills including verbal memory in addition to other core cognitive domains.

DESCRIPTION: Automating the administration of neurocognitive tests is inevitable and has a number of advantages including: 1) improved standardization, 2) reduced administration and scoring errors, 3) increased access to care, and 4) reduction in cost and examination time. Currently, a number of computer tests can be administered with minimal input from a trained tester. However, the ability to develop a primarily self-administering core test battery has been limited by requiring patients to read instructions and by the need to include tests requiring verbal responses. Technology now exists to overcome these limitations. Programs have been developed using avatars as interactive counselors and voice recognition technology has improved to the point that the basic word recognition needed to assess skills such as list learning and confrontation naming are now possible. In addition, computerized tests themselves enhance cognitive testing by permitting accurate response timing important for the assessment of concussion and a variety of neurological disorders. Computers have also expanded the range of tasks that can be administered as part of a cognitive assessment. Extensive experience using computerized tests within clinical settings as demonstrated their utility and feasibility with various neurological populations. Voice recognition will enhance the clinical utility of computerized metrics by improving the process of presenting instructions (visually and verbally) and by permitting patients with upper extremity motor impairments to respond verbally. In addition to being cost effective and improving the reliability of the assessment process, having a core neurocognitive test battery that is self-administering with minimal to no tester input addresses Army operational needs and long-term health objectives. Such a system will enhance telemedicine based assessment for underserved and remote locations including in theater and has the potential to be used in the patient centered medical home as part of a more general health monitoring program. Experience has also taught that even when potentially available, neurocognitive assessments are underutilized for patient assessment due to wait times for appointments, the examination length, and the turn-around time for reports. Consequently, increasing the capabilities of computerized assessment methods will improve services in medical centers as well as in the home and in remote locations. For these benefits to occur, the required next phase is to integrate improved instruction delivery and voice recognition into automated test systems. Consistent with current best practices, this enhanced system is not intended to replace the essential role of the clinician in integrating information and developing a formal assessment. Rather, it is intended to substantially update and streamline the testing process. Hence, the focus of this announcement is to develop an automated test system that can be reliably self-administered with minimal supervision, potentially using video or avatar based instructions, that incorporates language recognition to assess language-based cognitive domains and to provide an alternate method of responding to test stimuli for individuals who have significant upper motor limitations. The methods employed should be adaptable for telemedicine based-assessment to extend this capability to remote locations and to the home. These objectives are achievable through the integration and enhancement of current technologies.

PHASE I: Phase I will have two principal objectives. The first objective is to develop and demonstrate a system for administering a battery of neurocognitive tests that is potentially self-administering with clearly presented directions using both visual illustrations and verbal instructions. A number of methods for doing this are possible and may include video and avatar-based instructions. The second objective is to demonstrate the implementation of voice recognition that is sufficiently accurate to permit computer administration of verbally based tasks including word-list learning, confrontation naming, and aural comprehension. While current technology may not permit the direct assessment of word-list generation, contractors should consider the degree to which current capabilities would permit this type of assessment. The goal of Phase I is to produce a prototype test battery that is primarily self-administering and comprehensive with respect to core cognitive domains assessed including language-based skills. No studies involving human use can be conducted during Phase I in view of the 6-month period of performance.

PHASE II: The contractor will further develop, optimize, and demonstrate their self-administering neurocognitive test system. The contractor will refine the technology needed to present test instructions clearly and to assess verbal skills on the computer without input from or real-time response recording by an examiner. At the completion of Phase II, the contractor will have produced a computerized test battery that: 1) is essentially self-administering, 2) assesses core cognitive domains, 3) assesses key verbal skills without the aid of an examiner, and 4) has a verbal response option for individuals with upper extremity impairment. A pilot study should be completed at the end of Phase II demonstrating that the test system can administered to a to a select group of neurological patients.

PHASE III: The contractor will produce a self-administering computerized neurocognitive assessment system capable of meeting FDA standards which are expected to evolve over the next several years. Phase III will involve demonstrations of test reliability, the compilation of norms from relevant reference groups, and demonstrated utility for various clinical populations. The end product will be suitable for use in military and civilian medical clinics and deployable to remote locations. It will provide for a core neurocognitive assessment that is time efficient with respect to examination length and by providing immediate scoring of test results. Since the test system will be self-administered with minimal supervision, it will make maximum use of the limited number of trained neuropsychologists in the military and in a number of civilian clinical settings by focusing their efforts on providing clinical interpretation of test findings. This automated capability will have considerable commercial value in light of changes taking place in heal care delivery with respect to utilization and reimbursement. This system will result in timely service delivery reducing the time between the initial referral and the completion of the examination. It will also permit timely reporting of test results which currently can lag several weeks to a month post examination. The proposed system will both reduce the cost of individual examinations while making the service more accessible and more likely to be implemented when clinically indicated. In addition, it will be possible with further development to adopt this system for telemedicine applications such that service personnel and civilians will be able to undergo a detailed neurocognitive evaluation independent of their geographic location. Test development and validation is a continuing and ongoing process. However, at the end of Phase III, the contractor should produce an instrument that can be employed in military and civilian settings.

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KEYWORDS: Computerized Assessment, Telemedicine, language recognition, self-administering, neurocognitive

A13-091 TITLE: Remote Monitoring and Control of Custom, Tactical Services

TECHNOLOGY AREAS: Information Systems

OBJECTIVE: To investigate and propose an innovative and flexible approach that supports a broad range of capabilities that leverages and extends the state-of-the-art in service monitoring and control technologies, configurable and usable by soldiers, and remote help desks for monitoring and controlling critical factors and parameters associated with a diverse suite of custom services and applications.

DESCRIPTION: This topic is intended to incrementally advance the state-of-the art in service management with focus on remote monitoring and control capabilities suitable for a tactical environment constrained by limited bandwidth, restrictions imposed by Information Assurance policies, limited training, and evolving custom Mission Command (MC) applications and application architectures. Examples of MC applications include, but are not limited to CPOF, BCS3, AFATDS, and Enterprise Services (mail, portal, active directory, etc.). The proposal will demonstrate improvements in acquiring and reporting applications' vital signs. Vital signs are associated with HW and SW components that will adversely impact mission readiness/execution if not running or performing poorly and are different based on the system and the system's Mission Assurance Category (MAC). Some examples are CPU, Memory, concurrent thread execution, connectivity, etc. Innovations are needed in distributed, hierarchical tactical service management capabilities that optimize and balance the need for monitoring and situational awareness at upper echelons with the need for minimal BW consumption and intermittent connectivity. Consideration and innovations to existing government and/or commercial open source capabilities are desirable. Innovations that augment or enhance existing protocols like SNMP, Netflow, etc., are also of interest. Control innovations are sought to affect a reduction in application degradation, interruptions, failures and down-time that are common in the tactical environment. Innovations are needed in the area of algorithms and inputs that will enable intelligent controls such as custom application load balancing and re-configuration. The proposed solution must be configurable and customizable to accommodate the specific monitoring and control needs of a wide range of individual custom applications and architectures, with unique monitoring and control requirements. The proposal should also address mechanisms, automatic or manual, that will enable prioritization of monitoring and control capabilities based on available resource and/or mission constraints.

PHASE I: Provide a conceptual model/architecture, components, component architectures, resource requirement estimates (HW, SW, Training, Bandwidth, etc.), and concept of operations (CONOPS) for the proposed service management capabilities described above. Document proof-of-concept and feasibility analysis of key component technology innovations based on lab tests or simulations. Provide the high-level approach to development and commercialization of the proposed solution with key assumptions, risks, risk mitigation strategies, and timelines.

Phase I Deliverables
- Conceptual models
- Proposed solution's resource requirements in a tactical, operational environment
- List of innovations in service management components relative to the current state-of-the-art
- Component architectures
- CONOPs in tactical, operational environment
- Phase I Final Report

PHASE II: The scope of this phase will be a final design and prototype of the Service Management capability proposed in Phase I using applications and components (HW & SW) mutually agreed to by the government and the

proposer. The demonstration shall show that the proposed Service Management design can meet expected performance capabilities in conditions representative of Army tactical operations. An appropriate test case will be based on target tactical, distributed, hierarchical, network and service architectures that represent the issues of managing custom applications and the ability to customize, by application, the information retrieved, processed, and displayed.

PHASE III: The end-state demonstrated product will have dual-use value in commercial and government applications. Potential commercial market applications for these innovations include Homeland Defense, first-responders, and local and Federal government organizations. In addition, documentation is required that describes the underlying methodologies, approaches, assumptions, capabilities and limitations.
The vendor is responsible for marketing its demonstrated Service Management capability for further development and maturation for potential Post-Phase II transition and integration opportunities including actual military Programs Of Record (POR) and any dual-use applications to other government and industry business areas.

REFERENCES:
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2. Commercial open source information: http://www.itmanagement.com/features/10-open-source-network-tools-052407/

3. Army Information Assurance information: https://ia.signal.army.mil/refLib.asp

4. Army Service and Network Operations Convergence: http://www.afcea-augusta.org/pdf/briefs/TCM%20GNE%20Mr%20Morrison.pdf

5. Tactical Network Overview: http://tactical-communicator.com/pdf/Commanders_Handbook_v1.6.pdf

6. Tactical application evolution design concepts
a. REST: http://www.ibm.com/developerworks/webservices/library/ws-restful/
b. Service Bus: http://en.wikipedia.org/wiki/Enterprise_service_bus
c. SOAP: http://en.wikipedia.org/wiki/SOAP

KEYWORDS: Custom Services, Service Control, Service Monitoring, REST, SOAP, Service Bus, SOA

A13-092 TITLE: C2 Store and Forward

TECHNOLOGY AREAS: Information Systems

OBJECTIVE: Improvements to C2 store and forward to accommodate network instability that would otherwise lose network data by existing static C2 and Networking architectures and algorithms.

DDESCRIPTION: Some Army systems do not retain C2 messages when operators are not within radio connectivity of the sender or their system has been turned off. The system operators need to be able to retrieve messages that were sent while their system was turned off as well as when they log into a new computer on a different platform. Must also provide controls to manage what information is available via this service.

- Solution provides for continuity of operations due to disconnections from the "network".
- Implementation must be adaptive to virtually any network architecture. It must support applications and services implemented with all identifiable permutations of current technology and work with any vendor (standards based).
- Solution may use commercial "cloud" like services but they must be tailored to support network-constrained environments.
- The solution must also support execution on hardware and software platforms with limited processing and storage capabilities.

PHASE I: Phase I will be a technical analysis and feasibility study to determine an analytical approach to establishing and defining the basic Command and Control (C2) Store and Forward system approach. The offeror

will identify the challenges and technical barriers to a implementing the Command and Control (C2) Store and Forward capability. This study will provide a detailed technical description of the approach, expected value, and any assumptions. It should also include a plan for measuring and demonstrating the value of the proposed approach.

PHASE II: The scope of the Phase II will be to develop a demonstration of the Command and Control (C2) Store and Forward proposed in Phase I. This demonstration shall show that the proposed Command and Control (C2) Store and Forward design can meet expected performance capabilities in conditions representative of Army tactical operations. An appropriate test case will be defined and can be based on either current tactical network systems or a commercial based mobile system that represent the issues of scale, mobility, wireless propagation and lack of fixed infrastructure appropriately.

TRL: (Technology Readiness Level) TRL Explanation Biomedical TRL Explanation
TRL 6 - System/subsystem model or prototype demonstration in a relevant environment

PHASE III: During this phase, three or more prototype Command and Control (C2) Store and Forward radios will be completed and delivered along with documentation. The prototypes will be tested and demonstrated to the government to show performance capabilities. In addition documentation that describes the underlying methodologies, approaches, assumptions, capabilities and limitations will be provided.

The end-state demonstrated prototypes being researched within this topic will have dual-use value in commercial and government application. Potential commercial market applications for this innovation include Homeland Defense, first-responders, and local and Federal government organizations.

The vendor is responsible for marketing its demonstrated Command and Control (C2) Store and Forward capability for further development and maturation for potential Post-Phase II transition and integration opportunities including actual military Programs of Record and any dual-use applications to other government and industry business areas.

REFERENCES:
1. http://roland.grc.nasa.gov/~ivancic/papers_presentations/2012/RobustNetworkingWorkshop062612.pdf

2. http://www.dtnrg.org/docs/tutorials/warthman-1.1.pdf

3. https://tools.ietf.org/html/rfc5050

4. http://sourceforge.net/directory/os:windows/freshness:recently-updated/?q=store%20and%20forward

5. http://peoc3t.army.mil/mc/tmc.php

6. http://peoc3t.army.mil/mc/docs/FSC_Brochure.pdf

7. http://peoc3t.army.mil/mc/docs/SBC_Brochure.pdf

8. http://peoc3t.army.mil/mc/docs/TMC_Brochure.pdf

9. http://peoc3t.army.mil/mc/docs/SusC2_Brochure.pdf

KEYWORDS: store and forward, network data, Networking architectures and algorithms, network instability

A13-093 TITLE: Continuous Wave UV Laser for ASE

TECHNOLOGY AREAS: Electronics

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 5.4.c.(8) of the solicitation.

OBJECTIVE: To develop a semiconductor laser system in the near-UV (UVA) that exceeds three (3) watts of power with diffraction limited performance. The laser shall operate without the use of cryogenically cooled components.

DESCRIPTION: The Army is interested in laser sources in the near-UV (UVA) for applications such as Light Detection and Ranging (LIDAR) and other applications for helicopter survivability. Conventional techniques for near-UV wavelength generation using non-linear components have limited efficiency and require large pump sources. Semiconductor laser diodes are attractive because of the potential for small size and high efficiency. The Army requires such devices as illuminating sources used, for example, in conjunction with a pointer tracker to locate small objects that may be in the path of a helicopter in flight. The near-UV laser output shall exceed three (3) watts continuous with diffraction limited performance. The laser can be designed with multiple laser chips combined to achieve the required power. For thermal management, cryogenic cooling is NOT an option; rather it is acceptable to use thermo electrically cooled or convection cooling. Packaging of the laser chips should consider minimizing the size, weight, and power (SWaP) consumption given the design proposed. The ultimate goal is to have the total weight of the optical components to be less than 5 pounds. The objective is to have a laser design that is directly driven but a laser pumped laser would also be considered. US Government contractors may be used in the evaluation of proposals.

PHASE I: Identify semiconductor materials suitable for near-UV (UVA) laser emission. Identify design methodologies and critical design parameters for a laser system that could be used on rotary wing platforms that exceeds three (3) watts of power with diffraction limited performance. Develop an initial system design and concept that achieves the requirements and capabilities. The result from Phase I will be a feasibility study for this system. The contractor shall deliver a detailed report on the analysis, results, conclusion, and a feasibility plan to address this effort.

PHASE II: Build a prototype laser system for government testing and evaluation. The prototype may be designed with a single chip to validate and mature the system design but eventually a complete laser system that addresses the requirements is required. Evaluate key elements of the system in a laboratory environment. The contractor shall deliver a detailed report of its efforts and its results.

PHASE III: DUAL USE COMMERCIALIZATION: Military Application: Transition into current aircraft protection, threat warning, and battlefield awareness systems. Commercial use may include small light weight wire detection LIDAR, detection of trace elements using LIDAR backscatter both for Homeland Security applications. Other commercial applications may be use of the UVA laser for etching and writing to disk, e.g. Blu-Ray discs.

REFERENCES:

1. Hamilton, C.E., Doughty, C.B., Roper, P.M., Mead, R.D. & Tidwell, S.C.; (1998). All solid-state, single-frequency 193-nm laser system for deep-UV metrology. Lasers and Electro-Optics Society Annual Meeting LEOS IEEE

2. Shu-Di Pan, Ke-Zhen Han, Xiu-Wei Fan, Jie Liu & Jing-Liang He (2007). Efficient fourth harmonic UV generation of passively Q-switched Nd:GdVO4/Cr4+:YAG lasers. Optics & Laser Technology, Vol 39, Issue 5, 1030-1032

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4. Kojima, T., Konno, S., Fujikawa, S., Yasui, K., Yoshizawa, K., Mori, Y., Sasaki, T., Tanaka, M. & Okada, Y. (2000). 20-W ultraviolet-beam generation by fourth-harmonic generation of an all-solid-state laser. Optics Letters, Vol. 25, Issue 1, pp. 58-60

5. Continuous Wave UV Laser for ASE - Abbreviated Requirements Document, 2012, PM Aircraft Survivability Equipment

KEYWORDS: Ultra-Violet, Laser, Aircraft Survivability Equipment, ASE, Counter-measure, Countermeasure, Counter Measure, Aircraft, Force Protection, Force Protection On the Move

A13-094 TITLE: Anti-Jam GPS Antenna for Dismounted Use

TECHNOLOGY AREAS: Electronics

The technology within this topic is restricted under the International Traffic in Arms Regulation (ITAR), which controls the export and import of defense-related material and services. Offerors must disclose any proposed use of foreign nationals, their country of origin, and what tasks each would accomplish in the statement of work in accordance with section 5.4.c.(8) of the solicitation.

OBJECTIVE: The objective of this project is to develop and demonstrate a GPS antijam antenna that is small enough and has low enough power consumption to be used in a dismounted mode, on battery power.

DESCRIPTION: While GPS is the most prevalent navigation method in use today, its weak satellite signal is vulnerable to both unintentional interference and deliberate jamming from an adversary. With so much of the Army's operations and infrastructure depending on GPS, means are urgently needed to assure the continued availability of GPS-based PNT capabilities. The PNT Assurance Analysis of Alternatives (AoA) was initiated in Oct 2011 to determine optimum means of solving this issue. Preliminary AoA results indicate the most effective means of countering GPS interference & jamming is to include an active anti-jam (AJ) capability as an appliqué to the GPS device. The intent of this initiative is to develop a product that can work with existing receiver devices such as DAGR or GB-GRAM based devices, and also with emerging products such as the Mobile Handheld GPS (M/HH). This is a secure (SAASM-based) device being developed for use in conjunction with the Handheld Computing Environment (Android OS-based Smartphone).

Several varieties of active AJ device are in active use in the field today; these use a variety of interference suppression techniques including null steering, horizon nulling and Frequency Domain suppression. These products have varying degrees of success but all have three characteristics in common:
- They are power-hungry (multiple watts consumption)
- They are bulky and heavy (2-50 lb)
- They are expensive ($3-75K)

Therefore they have been confined to mounted use, almost exclusively in aviation. There is a need to develop & field an AJ capability (however limited) for dismounted use by foot soldiers on patrol.

This initiative should develop, demonstrate, and field an affordable & reliable dual-frequency (L1 and L2) anti-jam antenna solution that will provide at increased protection against common GPS jamming sources. The product should operate autonomously (no interaction with GPS receiver required), offer a simple user interface and connect to current and upcoming GPS ground receiver products (DAGR and M/HH). The solution shall not require any hardware or software modifications to the GPS receiver. Options that improve performance and efficiency through receiver software changes may be offered as objective functions. US Government support contractors may be used in the evaluation of proposals.

PHASE I: The Phase I deliverable will be a feasibility study documenting the past six months. This study should begin with identification of the most likely jamming sources for dismounted users (GPS Threat brief and PNT Assurance AoA results will be made available as source data). It should go on to identify likely existing products or technical developments that could be used to mitigate these threats while considering the draft requirements contain in the VARD. Key performance factors to consider are power draw, weight and cost (in that order). A tradeoff analysis should be conducted, a target technology selected and high risk requirements in the VARD identified with mitigation strategies recommended. The small business should design a wearable device with minimal SWAP and maximum ease of use.

PHASE II: Develop an initial prototype of the technology and demonstrate in a laboratory environment the technical merit of the proposed solution AJ antenna system; successfully collect information for analysis. Use of GPS Simulators and simulated jamming will be required for this phase; a successful offeror must be capable of obtaining and using a Y-code GPS Simulator under the provisions of CZE 93-295. Develop a plan which shall include detail for the development, demonstration, maturation, and validation and verification (V+V) of these capabilities which

will assist in Phase III transition. The small business will deliver a prototype based on the lessons learned and work performed in Phase I and Phase II.

PHASE III: Develop and implement a technology transition plan with Product Director Positioning Navigation and Timing (PD PNT). The transition should include further technology maturation to include potential means of operator control and capability to embed DAJA electronics into the M/HH device. Finalize the AJ hardware and software, and conduct qualification testing of the product with DAGR, GB-GRAM-based handhelds (PFED, etc) and M/HH. This technology is applicable to the US Army and other DoD users that require Assured PNT capability. The envisioned production rate is 2000 DAJA units per month, for a total of approximately 100,000 systems to support Army dismounted PNT requirements.

REFERENCES:
1. Assistant Secretary of Defense, Command Control Communications and Intelligence (ASD/C3I) Memorandum for all Service Acquisition Executives, dated August 23, 2000

2. CJCSI 6130.01D, 2007 Master Positioning, Navigation & Timing Plan, dated 13 April 2007

3. IS-GPS-164, GPS User Equipment Interface Specification for Defense Advanced GPS Receiver (DAGR) Unique Interface Characteristics

4. Very Abbreviated Requirements Document, Anti-Jam GPS Antenna for Dismounted Use, PD PNT, 7 November 2012

5. The GPS-SP Very Abbreviated Requirements Document is provided as a reference document to understand the planned future dismount PNT solution, uploaded in SITIS 5/23/13.

KEYWORDS: GPS, Global Positioning System, Anti-Jam, Antenna, Dismount, Soldier, Position, Navigation, Timing, PNT

A13-095 TITLE: Warfighter Universal Power Converter (WUPC)

TECHNOLOGY AREAS: Electronics

OBJECTIVE: Enable units with a light-weight, assault pack portable power generation and management capability that will decrease the amount of batteries carried and decrease dependency on logistical support and provide operational flexibility and facilitate the reallocation of combat and logistical resources in Tier 1 Warfighter environments with a light-weight small universal power converter.

DESCRIPTION: The ability to provide Soldiers small (<=1.5"Hx2"Wx4"L) light weight (<1 Lbs) universal power conversion that takes universal power from a variety of sources to include: 100-240V AC, 10W-300W solar panel/blanket, NATO Slave Adaptor, Cigarette Adaptor, 120V AC plug, 1KW GENSET, Car Battery ("Jumper Cable"), 300W and 50W Fuel Cells, and numerous batteries (BB2590, BA 5590, BB2557, BB390, BA 2800, BB-5800, MBITR (AN/PRC-148/152), Riflemen Radio, AN/PRC-154 Battery, AN/PRC-153 Battery, RCR-12, LI-80, LI-145, Conformal Battery) and provide clean power to a requisite items (10 to 20 VDC to a Soldier Power Manager or source 110VAC output power.

The objectives of this effort are to miniaturize (see size objective above) and provide enhanced power conversion (>90% efficiency) from Solar that requires Maximum Power Point Tracking (MPPT) (or numerous other DC input Sources) to either a fixed DC output (12 to 28 VDC) or convert solar power to a 110VAC output in a rugged, small, lightweight, efficient all weather package. This will be a bi-directional power device that can efficiently take generic 110-220 VAC and output a fixed DC Voltage (e.g. 12 -28 VDC) or take in various DC inputs from batteries, solar, fuel cells, noisy vehicles and convert to either a fixed (e.g. 12 -28 VDC) clean voltage at 150 Watts output (Threshold); 300 Watts (Objective - selectable) or to a 110 VAC output. Item must operate in Soldier field operational environments (such as military standards for temperature hot/cold, vibration/shock/drop, rain, sun, dust). Output: 150 Watt Threshold; 300 Watt Objective output power. Please note, US Government Support Contractors will be part of the Evaluation of Proposals for this topic.

PHASE I: Identify potential technologies, including commercial off-the-shelf (COTS) electronics, and analyze, design, and conduct proof-of-principle demonstrations 1) to verify that the proposed Warfighter Universal Power Converter design characteristics functions at ranges suitable for deployment and 2) to assess overall packaging to encompass size, weight, power, efficiency, heat, and ruggedness, and the ability to operate in Soldier Tier 1 (most austere - in woods/forward areas) environments. Provide proposed solutions that meet light-weight and small Soldier form factor size and power requirements. In order to be considered for this effort, the bidding firm must also show that they are capable of performing proof-of-principle experiments.

PHASE II: Design, build, and test a Warfighter Universal Power Converter that utilizes COTS or newly designed high efficiency, small sized circuits based on power and packaging requirements. Requirements defined in this SBIR description and in referenced CDD below should be the basis of design and prototypes developed and tested. Other issues that should be addressed in Phase II are hardening the technology to survive Soldier environments, handling, and ease of use along with considerations for low-cost production processes for mass production.

PHASE III: The Warfighter Universal Power Converter technology developed under phase II would be incorporated into the Expeditionary Soldier Systems for DoD (Army, USMC, USAF) Tier 1 mission operations and as applicable in many other environments from homeland security to commercial use in camping and in vehicles. This device would add a common capability to the Warfighter and reduce several pounds of weight on the Soldier's load as well as reduce size / volume for all Warfighter powered items to be employed in Tier 1 to Tier 3 environments. This light-weight, small efficient device would be employed ubiquitously across DoD services.

REFERENCES:
[1] Capability Development Document For (U) Small Unit Power Increment: I ACAT: III Validation Authority: HQDA, Approval Authority: HQDA, Milestone Decision Authority: HQDA, Designation: Joint Information (CDTM Document Number: 12120110998 - v 1.01 generated on 5/22/2012)

6.3 (U) KPP/KSA/Other Attributes Rollup. (U) The SPM must provide dismounted squads and platoons the ability to operate independently without routine resupply for extended duration missions, (T=48 hours).

The SPM must provide the capability to monitor state of charge while charging batteries by means of unit equipment. (T) State of charge indication shall be measured in percentage of total battery capacity within 5% accuracy of actual (T). System must have a visual indication when each battery is fully recharged (T).

SPM must accept power from multiple sources, to include: 100-240V AC, 10W-300W solar panel/blanket, NATO Slave Adaptor, Cigarette Adaptor, 120V AC, 1KW GENSET, Car Battery (“Jumper Cable”), 300W and 50W Fuel Cells, and numerous batteries (BB2590, BA 5590, BB2557, BB390, BA 2800, BB-5800, MBITR, (AN/PRC-148/152), Riflemen Radio, AN/PRC-154 Battery, AN/PRC-153 Battery, RCR-12, LI-80, LI-145, Conformal Battery) (T).

[2] Maxim Power Point Tracking - http://en.wikipedia.org/wiki/Maximum_power_point_tracking

[3] Military Environmental Tests (MIL-STD-810G): http://en.wikipedia.org/wiki/MIL-STD-810

[4] Military Operational Environments - http://www.dtic.mil/doctrine/jel/service_pubs/fm3_0a.pdf

KEYWORDS: Expeditionary Soldier Power, Sensors, Conversion, AC Power, DC Power, Lighting the Soldier Load, Power DC to AC Inverter, Operational Flexibility.

A13-096 TITLE: Advanced Laser Protection for Optics

TECHNOLOGY AREAS: Materials/Processes

OBJECTIVE: Research and develop a new and innovative method of laser protection for direct view optical systems. Such protection must provide a low-cost method of protection from directed energy threats while simultaneously not limiting the performance of a direct-view optical sighting system.

DESCRIPTION: Lasers and other directed energy threats to the Warfighter are proliferating through the contemporary battlespace with unprecedented alacrity. Such directed energy weapons pose a significant threat to the Warfighter, particularly with respect to the Warfighter's vision. Even a relatively low power directed energy threat can do significant and permanent damage to the Warfighter's eyes. When viewed through a magnified optic, this risk goes up even further.

Currently, all Army magnified direct view optics are mandated to have a laser filter unit (LFU) to protect from common threats. The LFU is an optical filter which filters out the wavelengths of common lasers. While effective, the reduction in total transmission through the optic which naturally results is often times detrimental to the Warfighter's performance, particularly so in low-light/dusk situations. Further, the cost of such filters when purchased in very high quantities ends up becoming highly prohibitive to procurement; often times the largest cost-driver in the procurement of a magnified direct view optic is the LFU.

A new solution for laser protection should not reduce the Warfighter's ability to operate in all illumination environments; when a threat presents itself, the solution may block transmission of light, however when no threat is present the total transmission of the system should not be reduced. The multispectral nature of laser threats on the modern battlefield requires a wide band of wavelength rejection; the solution system is required to block laser threats from 0.35µ to 1.2µ. In order to provide adequate protection, transmission must be reduced to an effective optical density (OD) of 4 (threshold), or 6 (objective). Because this is a component for use on a dismounted platform, an unpowered solution is desired, however, if power is required, power management concerns should be addressed and power requirements should be minimized. Solutions should be designed with specific US Army optical sighting systems in mind, but should be compatible with all military grade direct view sighting systems. The system must be functional in external temperatures from -20C to +50C, and must not take damage while being stored in temperature ranges from -40C to +70C. The system must be resistant to weapon fire shock consistent with the M4 carbine weapon platform. While the laser protection component itself does not need to be abrasion resistant, the final system must be able to withstand MIL-STD-810G blowing sand and dust while retaining full functionality (i.e., no depreciation of optical performance of the weapon optic due to scratched optical surfaces). Final production cost of the system (in quantities of ~10,000) is anticipated to be = $100 per unit.

PHASE I: Investigate innovative solutions to protection from optical threats, weighing required protection against increased weight and potential power concerns. Select and develop multiple approaches to meeting the topic requirements. Develop initial device/component designs for at least one critical approach to ensuring high transmission through the optical platform without compromising protection. Conduct proof of concept demonstration of core technology, showing the key components in a laboratory environment.

PHASE II: Conduct design review of the breadboard prototype developed in Phase I, and use that prototype as a basis to develop and demonstrate a prototype component for use on a standard issue direct view optic, the M150 RCO. The component will be capable of integrating with the M150 and robust enough for use in a theater representative environment. This prototype system must meet the environmental and shock requirements outlined in the description above. Functionality of the component will be demonstrated in outdoor environments and test ranges. Conduct testing to qualify the degree of protection afforded by the component relative to the current LFU. Redesign will be conducted as necessary, and final output of Phase II will be a production representative unit.

PHASE III: Evaluate the prototype for ruggedness and producibility. Conduct production studies, and modify the design further to reduce cost of production and increase yield. Begin low rate initial production and conduct operational readiness reviews. Dual use capabilities include use in commercial laboratory eye protection, tuning output for optical communication, commercial eyeglasses, and high sensitivity CCD cameras.

REFERENCES:
1. N. Kreidl, "Photochromic Glass", Leonardo, Vol. 3, No. 4, pg. 429-432.

2. http://www.physorg.com/news159732927.html

3. http://www.physorg.com/news158582784.html

4. http://www.physorg.com/news94042930.html

5. MIL-STD-1425A, Safety Design Requirements for Military Lasers and Associated Support Equipment.

KEYWORDS: Laser Filter, Eye Protection, Photoresponse.